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DISEASES DUE TO PROTOZOAN PARASITES.

(a) AMOEBIASIS.

MACFIE (J. W. Scott). **A Case of Amoebic Dysentery in a Monkey.**—*Report of the Accra Laboratory for the Year 1915.* pp. 74–75. With 1 coloured plate comprising 4 figs. 1916. London, W: J. & A. Churchill.

A case of amoebic dysentery is described in a small monkey, *Cercopithecus petaurista,* used for inoculation with a strain of human trypanosome at the Accra Laboratory, West Africa; it died unexpectedly on the 65th day after inoculation, having shown symptoms of diarrhoea for some time, but appearing otherwise healthy.

On post-mortem examination the mucous membrane of large intestine was found to be congested and studded all over with ulcers which were most numerous near the caecum. Each ulcer was roughly circular with a central slough and raised, ragged, blood-stained edges.

In fresh preparations of the contents of the large intestine numerous amoebae were seen. When stained these measured from 12 to 30μ in diameter; the cytoplasm was much vacuolated and contained numerous bacteria-like chromidia. The nucleus was somewhat indistinctly stained by Leishman's method and appeared to possess a fine chromatin network but no distinct karyosome. In sections large numbers of the amoebae were seen in the bases of the ulcers and penetrating into the adjacent layers of the intestine.

Numerous cysts were also present, measuring, as a rule, 12 to 18μ in diameter, but some larger forms were seen which measured as much as 33μ; these possessed a thick wall, which stained red with Leishman's stain, and a single large vacuole occupying the greater part of the interior; the number of nuclei varied greatly—in some cysts there was only one, but in others there were several. These cysts somewhat resembled the bodies described by ALEXEIEFF (1911) under the name *Blastocystis enterocola.*

The name *Entamoeba cercopitheci* is suggested for the parasite.

Vast numbers of minute spirochaetes averaging 5·28μ in length were also found in smears from the large intestine; these resembled *Spirochaeta eurygyrata* found in human faeces and there was no evidence that they were pathogenic in this case.

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EICHHORN (A.) & GALLAGHER (B.). **Spontaneous Amebic Dysentery in Monkeys.**—*Jl. Infect. Dis.* 1916. Sept. Vol. 19. No. 3. pp. 395–407. With 6 figs.

The outbreak here described occurred in a batch of 15 spider monkeys (*Ateles ater*) kept at the National Zoological Park, Washington, U.S.A., and imported between July and December 1915 from Colombia and Salvador. The monkeys ranged in age from 2 to 5 years and were placed together in a large exhibition cage. One of the monkeys, received on October 26th, showed symptoms of illness on arrival, similar to those manifested later by the others, and it appears probable that this monkey introduced the infection. Eight animals out of the total of 15 exposed succumbed, and of nine showing symptoms only one recovered. While in captivity it was noticed that these spider monkeys had developed a depraved appetite for the faeces which they evacuated. A minute history of the disease in each animal is given.

The symptoms shown were briefly as follows:—Marked dejection, temperature remained practically normal, and appetite, while diminished, was fairly good up to the time of death; loss of weight, but emaciation not marked. The principal symptom was severe diarrhoea, the faeces being usually of a fluid consistency, yellowish grey in colour, and foetid, containing at times a considerable amount of mucus with yellowish flakes; in the more acute cases the faeces were sometimes blood-stained. In several cases the symptoms were apparent for only two or three days before death, while in other cases they lasted for a period of from two to four weeks, the animal at times appearing to have somewhat recovered, and then it would relapse and die suddenly.

On post-mortem examination the caecum and colon were found affected in all eight cases, the rectum being involved to a greater or less degree. No visible lesions could be found in other portions of the gastro-intestinal tract. Abscesses were found in the liver in two cases. The lymphatic glands in the neighbourhood of the colon were sometimes found to be enlarged and oedematous.

The lesions in the large intestine were pronounced and took the form of a dense corrugation and necrosis of the mucous membrane, which in advanced cases was affected nearly throughout. In milder cases the lesions took the form of numerous small ulcers from 1 mm. to 1 cm. in diameter, well separated from each other, and presenting raised, congested, irregular borders. The affected portions of the intestine which had not become ulcerated were covered with a thick, amorphous, diphtheritic material. The deep ulcers penetrated beyond the submucosa, but no indication of the condition in the lumen of the intestine was apparent from the peritoneal surface.

Abscesses of the liver were found in the two cases showing most extensive intestinal lesions; in one case, only one abscess was present, while in the other case five fairly large abscesses and two smaller ones were observed.

A detailed account is given of the lesions involving the intestines and the liver in each animal.

No special attempt was made to determine the species of the amoebae. The amoeboid forms were especially numerous in the liver abscesses, but could also be readily found in intestinal matter, the encysted forms being more numerous in the latter. In the vegetative stage they

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showed very active protoplasmic changes when taken fresh from the pus of liver abscesses or from faecal material.

To determine the relationship of the causal organism of this disease, named *Amoeba ateles* by the authors, to the tropical dysentery of man an attempt was made to transmit the disease to cats, since these animals are susceptible to *Amoeba histolytica*. Feeding experiments on four cats gave negative results, suggesting that the parasite belonged to a different species from that of man. It is stated, however, that the results do not warrant any conclusions as to the pathogenicity of this parasite in cats, since failure of transmission to a limited number of animals is not sufficient evidence as various investigators have found that the transmission of human amoebic dysentery to cats is not invariably successful.

(b) Anaplasmosis.

Finzi (G.) & Campus (A.). **Anaplasmosi. Sul significato dei " Corpi Endoglobulari " " Punti Marginali " " Anaplasmi ", trovati nel sangue degli ovini della Sardegna e del Piemonte.** [Anaplasmosis. The Significance of " Intra-corpuscular Bodies," " Marginal Points," "Anaplasms " found in the Blood of Sheep from Sardinia and Piedmont.]—*Nuovo Ercolani.*, 1916. Oct. 31–Nov. 10, Dec. 10–20, and 1917 Jan. 15–31. Vols. 21 & 22. Nos. 30–31, 34–35, and 1–2 respectively. pp. 493–500, 557–571, and 2–8 respectively.

The greater part of this article is concerned with an exhaustive survey of the literature dealing with the subject of anaplasms since they were first incriminated by Theiler in 1908 as the cause of the so-called " gall-sickness " of cattle in South Africa. Various authors have since found these bodies in the blood of cattle suffering from diseases clinically resembling gall-sickness in widely separated parts of the world.

A description of the morphology and incidence of anaplasms in the blood is given. Numerous observers have recently discovered similar structures in the blood of other species of animals, particularly in animals suffering from diseases characterised by grave anaemia; considerable doubt has thus been shed on the specificity of anaplasms, many observers holding that they are merely artefacts, forms of degeneration accompanying anaemia, or remains of other blood parasites. The views of authors who have attempted to disprove the parasitic nature of the structures are very fully entered into.

The observations made by Finzi and Campus were limited to a few sheep imported for experimental purposes from Sardinia.

" Tibaldi (1914), considering that in Sardinia—on account of its geographical position, frequent inter-communication with the coast of Africa, and the great abundance of Ixodidae and other arthropods—haemoparasitic protozoa could not be lacking examined numerous smears prepared from the blood of various Sardinian animals, and he found, in fact, after methodical researches, forms of anaplasms in the dog, pig, horse, sheep, and guinea-pig."

One of the imported sheep kept under the authors' observation, after a few months, developed acute symptoms of liver-fluke disease. On examination of blood smears a large number of red blood corpuscles were found to contain in the centre, but more frequently at the

periphery, coccus-shaped bodies, which took on an intense chromatin tint, and were considered to be absolutely identical with the protozoan structures named by authors " marginal points " or " anaplasms."

On examining the blood of the remaining six sheep it was found that in the case of two of them the red blood corpuscles were invaded with similar bodies to the extent of 30 per cent. These two sheep showed manifestations of anaemia and the eggs of the liver fluke were found in their faeces. The sheep showing these structures were obviously suffering from fluke disease.

Examination of blood from sheep in two districts in Italy was then undertaken and in some of these sheep bodies similar to anaplasms were discovered, but it had to be admitted that these sheep were also suffering from fluke disease.

The authors endeavoured to elucidate the problem as to the nature of these structures by provoking experimental anaemia in sheep and rabbits. Some of the rabbits were deprived of their spleens as one of the authors (Finzi) had previously demonstrated the destructive power of the spleen on haemoglobin. Some of the animals were inoculated with a large quantity of distilled water and others with a specific anti-red-corpuscle serum. Smears were made from the blood at varying intervals.

The usual anaemia changes in the red blood corpuscles were seen and a large number of the corpuscles were alleged to contain bodies similar to marginal points.

The authors' conclusions are as follows :—

" (1) The observations made by Tibaldi in Sardinia and our own observations do not allow of our affirming the existence of anaplasmosis in Sardinian sheep.

" (2) It is easily proved that ' marginal and central points ' can be found also in the red blood corpuscles of Piedmontese sheep.

" (3) The marginal and central structures are not always the real and true parasites.

" (4) The intracorpuscular marginal and central bodies are frequently signs of changes of the blood commonly observed in the anaemic state.

" (5) Acute secondary anaemia following grave distomatiasis gives rise, in the sheep, to the possible appearance within the red blood corpuscles of certain round corpuscles, coccus-shaped, 0·1 to 0·5 microns in diameter, placed either at the periphery or centre of the corpuscle.

" (6) The anaemia following the injection of specific haemolytic sera into sheep also produced changes in the corpuscles represented by the appearance of dots and of central and peripheral granules.

" (7) The anaemia following the injection of distilled water shows, in normal rabbits and in rabbits deprived of their spleens, changes in the blood exactly comparable to those observed in sheep affected with anaemia produced experimentally by specific haemolytic serum.

" (8) The results of our experiments fully confirm the conclusions arrived at by Dias and Aragao and by Laveran and Franchini.

" (9) Although convinced that not all the forms of disease described as anaplasmosis are real and true diseases due to a specific protozoan, and that the ' intracorpuscular bodies ' or ' marginal points ' may have much less significance than some authors have thought fit to attribute to them, nevertheless the observations of Theiler and Lignières — and more especially those of the latter author—require that anaplasmosis should be considered amongst the protozoan diseases due to parasites of a special type which should be considered as a separate and distinct on its own account and as a clearly defined morbid entity."

[The object of these authors' experiments cannot be understood as the anaemia provoked by their methods would naturally have been

expected to give rise to the well-known changes in the corpuscles known as punctate degeneration. Moreover, the authors do not seem to have taken into account the clinical nature of the disease, the descriptions of the South African gall-sickness not corresponding in any way with the disease described in their sheep.

As regards the confusion between gall-sickness or anaplasmosis and ordinary redwater it appears that these diseases can be easily distinguished experimentally, for when blood containing the causal organisms of both diseases is inoculated into a susceptible animal the reaction set up by the one disease takes place much later than in the case of the other.—Ed.]

(c) Coccidiosis.

Guillebeau (A.). **Parasitisches Vorkommen von *Eimeria Stiedae* (Lindemann) in der Leber des Hundes.**—[*Eimeria stiedae* Lindemann in the Dog's Liver.]—*Schweiz. Arch. Tierheilk.* 1916. Nov. Vol. 58. No. 11. pp. 596–602. With 6 text figs.

Coccidiosis of the liver, although common in rabbits, is very rarely found in the pig (Johne), and in the dog (Rivolta, Perroncito). Bornhauser (1912) described the occurrence of coccidia in the epithelium lining the bile duct and in the liver parenchyma of the dog; these parasites were much larger than those found by the author, and belonged to the so-called *Diplospora* (or *Isospora*) *bigemina*.

The two cases described by the author occurred in old dogs (10 and 13 years old, respectively,) in which the most marked symptom during life was great enlargement of the abdominal cavity.

On post-mortem examination this was found to be caused by the presence of a large quantity of blood-stained exudate. The spleens were enlarged. The liver was also increased in size and distorted in appearance. In one case numerous soft dark red centres ½ to 1 cm. in diameter could be seen on the surface of the liver and in both cases these were found to be numerous in the parenchyma.

Microscopic examination of scrapings from these nodules showed the presence of red blood corpuscles among which were found a large number of small parasites, uniform in shape, measuring 7 by 12μ, containing a nucleus 3μ in diameter. This nucleus underwent changes after exposure to the air for a day. These parasites are smaller than those found in rabbit coccidiosis, in which the parasites, as a rule, measure from 20 to 50μ in length by 20–39μ broad.

Histology.—The less advanced lesions were found to be composed of a network formed of trabeculae of liver cells and filled with red blood corpuscles. The liver cells were nucleated and contained a granular protoplasm in which were found rounded lightly-staining parasites 1μ in diameter containing a small point which stained deeply with haematoxylin. These parasites were considered to be the schizonts of coccidia.

In the more advanced lesions distension of the blood vessels becomes more and more marked while the liver trabeculae become shrunk down to 20 or even 4μ in thickness, and covered at a distance of 4μ on either side by a membrane about 2μ in thickness corresponding to the walls of the intralobular capillaries. The trabeculae finally disappear

completely until in places the section is composed almost entirely of red blood corpuscles, among which are found numerous coccidian zygotes.

(d) Bird Malaria.

Brug (S. L.). **Morphologische Studien an *Proteosoma praecox*.** [Morphological Studies on *Proteosoma praecox*.]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1916. July. Vol. 20. No. 13. pp. 289–306. With 2 coloured plates, comprising 104 figs.

These studies were undertaken with the object of determining whether certain forms could be seen which had caused Hartmann to classify Proteosoma among the Binucleata.

The material was obtained from the blood of canaries infected with Proteosoma. The best preparations were obtained after drying and fixing with alcohol, and staining with Giemsa for three to four hours. Good results were also obtained by using Kiewiet de Jonges stain consisting of Azur II 40 mg., eosin 25 mg., methyl alcohol 25 cc. This stain was placed on the unfixed smear, an equal quantity of distilled water added immediately, and then allowed to stand for from one-half to one hour. Other methods of fixation and staining are also described, but the results obtained were not good.

The various stages in the life-cycle of the parasite are very well depicted in the coloured plates.

In order to study the development of the microgametes the slide covered with the fresh blood film was placed for from 10 to 75 minutes in a moist chamber consisting of a Petri dish containing some moist blotting paper, and then dried and stained with Giemsa. Better preparations are obtained in this way than when blood is taken from the stomach of flies, as in the latter case it soon coagulates and poor smears can only be obtained. The author dwells at some length on the analogy which some authors have thought to exist between the microgametes and the trypanosomes.

The conclusions are as follows :—

"(1) In the life-cycle of Proteosoma there occurs a stage in which these organisms appear bi-nucleated, recalling somewhat the same characters of certain flagellates. In young schizonts there is often seen an accessory nucleus which divides by amitotic division.

"(2) The half or fully grown schizonts, the sexual forms, the ookinetes, show no accessory nucleus (blepharoblasts).

"(3) Although the bi-nucleated character of the young schizonts can be brought forward in order to indicate the resemblance between the Proteosoma and Trypanosomidae the differences between them are too great to enable one to classify them in the same order. (It is always questionable whether there exists a sexual stage in the Trypanosomidae, etc.).

"(4) The gametes in the peripheral blood in cases of experimental infection of canaries with Proteosoma by means of blood inoculation often appear at the same time as the schizonts. Their appearance is not consequent upon commencing immunisation.

"(5) The microgametes are built out of a chromatin net found towards the periphery of the microgametocytes. Certain forms can be found among these which can be mistaken more or less easily for the structure of a trypanosome.

"(6) Reduction bodies are extruded in the process of maturation of the macrogametocytes."

(e) Spirochaetosis.

Bekensky (P.). **Contribution à l'étude des spirochètes des voies digestives des porcs dans leurs rapports avec la peste porcine.** [The Relation between the Intestinal Spirochaetes of Pigs and Swine Fever.]—*Rec. Méd. Vét.* 1916. Oct. 15. Vol. 92. No. 19. pp. 545–552.

In this preliminary communication from the veterinary laboratory of the Ministry of the Interior at Petrograd, the author first brings under review the works of various investigators who have of late years discovered spirochaetes in the blood, intestines, and cutaneous lesions of pigs affected with swine fever. Reference is made to the publications of Smith (1894), Siegel, Dodd, Poenaru (1906), Cleland, Gilruth, and Ruther.

The works of the American authors, King, Hoffman, Drake, and Baslack are also reviewed at some length. These authors, in a series of articles, claim to have discovered short rare spirochaetes in the blood of swine fever affected pigs, and also somewhat longer ones in scrapings from intestinal ulcers, the mucus covering the caecal ulcers, and towards the ileo-caecal valve, as well as in the external lesions of affected pigs. These organisms could not be discovered in the other organs and tissues. In recovered pigs the spirochaetes were observed to disappear. These investigators thus concluded that in the mucus covering the caecum of healthy pigs there exist a number of large non-pathogenic spirochaetes; in the ulcers of the caecum and along the ileo-caecal valve of swine fever affected pigs one nearly always finds spirochaetes of a special kind which play a part in the evolution of swine fever. They are further of opinion that the morphological differences between the spirochaetes found in the blood and in the ulcers and local lesions of affected pigs might arise on account of the influence of the blood as a medium on the spirochaetes, or on account of the natural evolution of the organisms.

Arnheim, critisising the conclusions of the preceding authors found that salvarsan, which is toxic for spirochaetes, has no influence on swine fever, and also he was able to find spirochaetes in the blood of affected pigs only on one occasion.

Bekensky thus, from a study of the literature, concludes that there is no agreement on the question of the relationship between the intestinal spirochaetes and swine fever.

The question was studied by him on the carcases of pigs sent to the laboratory for diagnosis, the caeca and recta of healthy pigs collected at the Municipal Abbatoir at Petrograd, live healthy pigs hyper-immunised against swine fever, pigs among which outbreaks of swine fever had occurred, and, finally, pigs among which anthrax had broken out. A very thorough examination for the presence of spirochaetes was made on these animals.

After a considerable number of failures mixed cultures of spirochaetes were obtained for use in experiments on sucking pigs.

Detailed measurements of the spirochaetes, including length, number of spirals, length and amplitude of the spirals, were also taken.

The author concludes as follows:—

"In the examination of pigs affected with swine fever, spirochaetes were discovered in a large number of cases, but not always (58·7 per cent.),

It was brought out that spirochaetes could be found in the case of pigs living in establishments where swine fever existed (17 per cent.), and on the contrary when pigs were affected with swine erysipelas or with anthrax spirochaetes were not once found.

"In the case of sucking pigs artificially infected with the ultra-visible virus, spirochaetes were discovered in nearly all cases (17 out of 19).

"In the case of pigs inoculated and drenched with mixed cultures of spirochaetes and in pigs placed in contact with these animals spirochaetes were discovered in all cases (7), but one must bear in mind that at the same time in these experiments the typical picture of swine fever was not obtainable. *These facts seem to point out that in pigs suffering from swine fever the spirochaetes found in the intestinal tract play a certain etiological role, in the same manner as the other micro-organisms which provoke a secondary infection, the fundamental disease being due to the ultra-visible virus.* Moreover, in the case of hyper-immunised pigs in the bodies of which one would suspect the presence of swine fever antibodies spirochaetes were not discovered on any occasion. The fact that spirochaetes have been found in healthy pigs in establishments perfectly free from swine fever does not contradict this statement; the experiments of UHLENHUTH, GABBERT, and others on *B. suipestifer*, and the experiments of SMITH, MOORE, BANG, JENSEN, KARLINSKI, KITT, KLEIN, and others on *B. suisepticus*, show that agents of secondary infection are encountered in the bodies of healthy animals. The frequency of spirochaetes in healthy pigs varies from 7 to 12 per cent.

"*On one hand*, it is admissible that on account of the lowered resistance of the body and the influence of the ultra-visible virus the spirochaetes of the digestive tract, like other saprophytes present in the bodies of pigs and harmless for a certain time, acquire a greater power of reproduction and perhaps of pathogenicity on the pig's body in general, and especially in the direction of producing morbid lesions in the digestive tract.

"*The other side* of the question is by no means clear. Are the spirochaetes found in the digestive tract of pigs capable of producing a general infection or only a local action? Moreover, the work of observers who have found spirochaetes in the blood and cutaneous lesions of affected pigs does not exclude the probability that the spirochaetes found in the digestive tract of pigs are capable of passing into the blood by way of the lymphatics, and are thus the determining agents of swine fever. The fact that spirochaetes have not been discovered by us in the blood gives no reason for denying categorically the probability of this supposition, but it might indicate that the spirochaetes found in the blood are at a stage of their development in which their discovery would be very difficult.

"In conclusion, it is necessary to note that the spirochaetes found by us in the digestive tract of pigs, viz., spirochaetes with large and spirochaetes with small spiral wave lengths were found together in every part of the digestive tract—in the case of healthy animals, as well as in pigs affected with swine fever."

(f) TRYPANOSOMIASES.

LAVERAN (A.). **Surra, nagana ferox, nagana de l'Ouganda et infections due au *Trypanosoma rhodesiense*.** [Surra, Nagana Ferox, Uganda Nagana, and Infections due to *T. rhodesiense*.]—*Bull. Soc. Path. Exot.* 1916. Nov. Vol. 9. No. 9. pp. 731–738.

Differences of opinion have arisen among authors as to the relations existing between *T. brucei* and *T. rhodesiense*, and as to the unicity or plurality of the trypanosomiases described under the name of nagana. BRUCE and his collaborators, as the result of their researches, based principally on measurements, concluded that the above two trypanosomes were identical. The author in 1912 published the results of some cross-immunity tests which demonstrated that they were not identical. The biometrical method has been shown by DUKE, SCHILLING, and SCHRECK to be liable to give rise to errors.

It appears that animal trypanosomiases of different natures have been confounded under the name of nagana. The work of STEPHENS and BLACKLOCK shows that the parasite of Zululand nagana is a monomorphic trypanosome, whilst that of Uganda nagana is of the dimorphic type, and thus these trypanosomes cannot be identical. The name *T. ugandae* was given by them to the latter trypanosome. MESNIL'S cross-immunity tests also showed that these two types were different. Authors are agreed that Zululand nagana is quite distinct from surra. The identity of Zululand nagana and Uganda nagana being disputed, the author thought it would be interesting to find out whether goats immunised against Mauritius surra remained susceptible to Uganda nagana.

Five goats and one sheep were used in his experiments and the following viruses were employed: the Mauritius surra virus kept in the author's laboratory; the virus of nagana ferox from EHRLICH'S laboratory, maintained for several years in the author's laboratory; the virus of Uganda nagana obtained from BRUCE and kept in the author's or in MESNIL'S laboratory; and *T. rhodesiense* from the Runcorn Research Laboratory, Liverpool, kept for five years in the author's laboratory. A detailed account of each animal during the course of these experiments is given. The following is a résumé of the observations:—

Goat 1.—A clean goat, inoculated with Uganda virus, became infected, and died at the end of 66 days.

Goats 2 *&* 3.—These goats, immunised against surra, were inoculated with the Uganda virus, became infected and died, the first in 96 days, the second in 52 days.

In these three animals the infection produced by the Uganda virus was characterised by fever, wasting, and nervous symptoms during the last phase of the disease, consisting in paresis of the hind quarters, trembling, ataxic movements and convulsions; in the three cases the disease was fatal.

Goat 4.—Inoculated on the 10th September 1914 with Uganda nagana, became infected, and in the month of June 1915 it had acquired immunity against this trypanosomiasis. Inoculated on the 14th September 1915 with *T. rhodesiense* it became infected; in the month of June 1916 it had recovered and possessed immunity against this trypanosome; after inoculation on the 23rd August 1916 with the virus of nagana ferox it did not become infected.

Goat 5.—Inoculated with nagana ferox on the 6th April 1915, became infected, and in the month of September 1915 it was immune against this trypanosomiasis. After inoculation on the 22nd January 1916 with the virus of Uganda nagana on two separate occasions the goat did not become infected. After inoculation on the 16th August 1916 with *T. rhodesiense* it became infected.

The *sheep*, which had acquired, in August 1914, a strong immunity against nagana ferox, and was inoculated on the 13th November 1914 with the virus of Uganda nagana, became infected and died.

The following conclusions are drawn from these results:—

"(1) Goats 2 and 3, immune against Mauritius surra became infected with the virus of Uganda nagana in the same manner as the clean goat 1, and the disease presented the same degree of severity in the case of all three animals; Uganda nagana thus has no relationship with surra.

"Goat 4 immune against Uganda nagana, and Goat 5 immune against nagana ferox and Uganda nagana, when later inoculated with *T. rhodesiense* became infected; it thus results that the viruses of nagana ferox and Uganda nagana have no connection with *T. rhodesiense*.

"Goat 4, having acquired immunity against Uganda nagana and *T. rhodesiense*, did not become infected after inoculation with nagana ferox; the same applied to Goat 5, immune against nagana ferox and, inoculated twice with the virus of Uganda nagana, did not become infected; but, the sheep immune against nagana ferox was shown to be as susceptible as a clean animal to Uganda nagana.

"These last facts, which seem contradictory, can be explained if one admits that Uganda nagana and nagana ferox are varieties of the same species, one of the varieties having been able to acquire a higher degree of virulence than the other. I have not observed between the trypanosome of nagana ferox and that of Uganda morphological differences pronounced enough to exclude this hypothesis."

Mesnil, in discussing this paper, notes that in Laveran's experiments the sheep immune against nagana ferox, which seems to be only a laboratory variety of Zululand nagana, was as susceptible as a control animal to Uganda nagana. He also believes, however, in the specific identity of the viruses on account of the results obtained from the cross-immunity tests on goats.

Another point raised was that nagana ferox, or the laboratory Zululand nagana, consists of monomorphic trypanosomes. However, the Uganda nagana virus as seen by Bruce and his collaborators in the country it originated from—like that of Zululand nagana when introduced into Europe in 1896—was polymorphic, and was still so when Stephens and Blacklock studied it and sent it to him (Mesnil) in 1911, but in 1913 he already noted that it was in the process of losing its short and stumpy forms. Laveran now notes that it scarcely differs morphologically from nagana ferox. The nagana virus as well as *T. gambiense* and doubtlessly other viruses of the same group, from being naturally polymorphic, become monomorphic in laboratories.

Van Saceghem stated that in the Belgian Congo the *brucei* virus obtained from Zululand was polymorphic and that its polymorphism was maintained in equines, bovines, goats, sheep, rabbits, and guinea-pigs. On the other hand, in the white rat he only obtained intermediate forms of the trypanosome.

Mitzmain (M. B.). **Collected Studies on the Insect Transmission of *Trypanosoma Evansi*.—*Treasury Department. United States Public Health Service. Hygienic Laboratory Bulletin* No. 94. 1914. June. pp. 7–39. With 5 plates comprising 10 figs. Washington: Government Printing Office.**

In these studies the author undertook to ascertain the possible rôle in the transmission of surra of all the common flies found on horses and other susceptible animals in the Philippine Islands.

(1) *The Relation of* Tabanus striatus *to Surra Dissemination.*

An interesting account of the literature dealing with the association of the Tabanidae with animal trypanosome transmission is given. Reference is thus made to the work of Rogers (1901) with surra in India, Fraser and Symonds (1908) with surra in the Federated Malay States, Ed. and Et. Sergent (1905–1906) with the trypanosomiases encountered in Algeria, Bruce and his collaborators (1910)

with African cattle trypanosomiasis (*Trypanosoma pecorum*), LEESE (1911–1912) and BALDREY (1911) with surra in India, and MOHLER and THOMPSON (1909) with surra in imported Indian cattle.

In a previous series of experiments the author endeavoured to determine to what extent *Tabanus striatus* Fabricius, the common house (horse ?) fly of the Philippines, was involved as a mechanical carrier of trypanosomes. It was noted that in these experiments a very small percentage of positive results (3 out of 16 attempts) was obtained; it was concluded that the feeding methods employed restricted the normal behaviour of the flies, for, after the single insertion of the proboscis into the infected animal, the flies were noticed to complete their meal upon the healthy host. In nature the feeding is differently conducted as it was observed that owing to the irritability of the host a fly always required several insertions of its proboscis at short intervals into different hosts.

Two experiments in which the more natural behaviour of the gadfly was simulated resulted successfully, both animals, a horse and a bull, showing undisputable evidence of the disease.

In previous experiments trials with single flies resulted negatively when the fly was permitted to bite infected and healthy animals once only. An experiment was carried out in which a tabanid was induced to feed with the maximum number of interruptions, on two hosts alternately, with only a few seconds interval between the bites. The infected and healthy horse were thus each bitten 26 times. The healthy horse after an incubation period of 9 days presented symptoms and died 67 days later. The experiment was also successful when repeated on monkeys.

The length of time *Tabanus striatus* remains infective was determined by feeding a number of flies on an infected animal and transferring them on to susceptible animals at intervals varying from three minutes up to between three and four hours. It was found that 15 minutes is the maximum time during which the fly is able to infect through its biting.

In order to test the indirect method of infection, the author succeeded in keeping a limited number of flies alive under artificial conditions for 26 days in the case of two experiments and 21 days in the case of one experiment. After the initial engorgement on a surra-infected horse the flies were applied at intervals varying from one to two days up to 24–26 days upon susceptible horses. The results were entirely negative. The bodies of the dead flies, when inoculated into guinea-pigs and a horse during this period, did not produce surra.

The problem as to how many horses flies could infect successively was determined by exposing three horses, screened from each other, to the bites of flies which had contaminated their labia by biting a horse whose blood was swarming with trypanosomes. Forty-three flies thus fed on the sick horse, 43 on the first contact horse, 39 on the second contact horse, and 32 bites were completed on the third contact. After an incubation period of six days the first contact horse showed a rise of temperature together with trypanosomes in its blood and died on the 62nd day. The second and third contact horses remained healthy and no trypanosomes could be discovered in their blood either by microscopic examination or by inoculation into monkeys and guinea-pigs. This shows that the bite of *Tabanus striatus* is incapable of

infecting more than one horse as the result of a previous contamination.

The author next describes an outbreak of surra on the Government stock farm near Manila which, from a study of the topography of the district and the conditions in which the animals were placed, pointed to *Tabanus striatus* as being the most probable carrier of infection. Stallions kept in darkened stables did not contract the disease; daily examinations of their quarters showed an absence of gadflies, although the stable inhabiting species, *Hippobosca maculata* and *Stomoxys calcitrans*, in addition to several species of mosquitoes were encountered.

From an exhaustive study of the breeding places of the gadfly, *Tabanus striatus*, in Southern Luzon the author found that the distribution of the fly coincided exactly with the places where very serious outbreaks of surra occurred.

Many investigators have observed that Tabanidae do not infest animals kept in a darkened stable. The author refers to the observations of SCHAT (1903) in Java, LAVERAN and MESNIL (1907) on an outbreak of surra in cattle in Mauritius, and LEESE on the influence of dark stables in India in preventing the spread of surra.

An observation is recorded in which a horse infected with surra was allowed to remain in an open shed with eleven other horses and four bulls. Many stable flies and Hippoboscids were seen, but gadflies were not in evidence. None of the in-contact animals became infected.

The protection afforded by darkened stables was also shown during a trial in which three horses and two carabaos were placed in a partially darkened shed where three surra-infected carabaos in contiguous stalls were exposed to biting flies during the season of maximum tabanid infestation. The eight animals were not disturbed for a period of two months. Culicoides, Phlebotomus, and various species of mosquitoes were observed in addition to stable flies and Lyperosia. During the entire period two specimens only of *Tabanus striatus* were collected, although in the adjoining pastures they were extremely numerous. The five healthy animals remained uninfected as the result of the experiment.

(2) *The Relation of Mosquitoes to Surra.*

LEESE in particular among the authors quoted considered that he had satisfactorily eliminated Anopheles, Culex, and Stegomyia in several surra transmission experiments performed in India. In a large series of experiments with surra in the Philippines the author himself was not able to transmit the infection with several species of mosquitoes. Details of experiments are tabulated in which two species, viz., *Aedes* (*Stegomyia*) *calopus* and *Culex fatigans* are considered in relation to various hosts in the direct method of infection. Negative results only were obtained in all (seven) experiments.

In an experiment, the larvae were reared from the eggs of 300 specimens of the first of these two species of mosquitoes, fed previous to laying their eggs on an infected horse; these larvae were then applied to a healthy horse, with negative results; the matter of hereditary transmission was thus disposed of as well as transmission by the indirect method.

Mosquitoes were found to harbour surra trypanosomes for a greater length of time than any other blood-sucking insects. Several specimens of *Aedes* (*Stegomyia*) *calopus* were found to contain active trypano-

somes in the proventriculus for a period of 42 hours after the infective bite. No trypanosomes were found in the salivary glands or in the mouth parts during various periods up to 36 days. Thirty hours was the longest period the trypanosomes were found to be virulent by inoculation.

The author next describes a field experiment in which healthy horses were exposed by night to infection by contact with infected horses. The exposed horses were removed during the day-time in order to eliminate *Tabanus striatus* as a transmitting agent. None of the exposed horses became infected.

(3) *Notes on the Bionomics of* Lyperosia exigua *and the Relation of this Fly to Experimental Trypanosomiasis.*

This fly is the most common of all the species of blood-sucking flies on draught animals in the Philippine Islands. It is prevalent during all seasons and during all hours and is usually at rest on bovines at night, accompanying mosquitoes and sandflies. It is rarely found on horses. A detailed account of the life-cycle, which lasts on an average 9–11 days, is given. The probability of this fly acting as a mechanical transmitter has been mentioned by Schat, Leese, and Austen. In experimenting with this fly three methods of procedure were adopted, viz. :—(1) Exposing healthy animals and infected animals to the bites of flies under natural conditions. Here counts were made of flies taken in the act of biting the hosts kept in the open ; (2) the experimental animals were exposed in a screened stable to the biting of a specified number of flies collected from known sources ; (3) bred flies were applied from test tubes upon infected and healthy animals at stated intervals. The author's own summary of the results of these experiments is as follows :—

"Experiments in the direct method with *Lyperosia exigua* and *Trypanosoma evansi* gave negative results.

"Horses, which were exposed under natural conditions to the biting of flies infesting sick carabaos, did not become infected.

"When thousands of flies infested sick and healthy carabaos placed in a large screened inclosure no infection was transferred.

"Only negative results were obtained in the interrupted method of feeding flies in 13 experiments with various animals. In six trials there was no appreciable interval between the bites of flies removed from the infected hosts, and in seven experiments intervals occurred varying from 5 hours to 10 days. The greatest number of flies employed was 61.

"In one experiment with several thousands of flies the possibility of transmission of *Tr. evansi* hereditarily was eliminated."

(4) *Mechanical Transmission Experiments with* Philaematomyia crassirostris.

This species of fly is as numerous as the ubiquitous stable fly especially during the months of April and May. It has previously been described in India and Africa and is noted for its peculiar mouth apparatus which, at first sight, would appear to belong to a non-blood-sucking form. It preferably infests cattle.

Experiments in the direct method of transmission proved unsuccessful at intervals of less than one minute, an hour, and 24 hours. One experiment only proved successful ; a monkey became infected

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Experiments in the direct method of transmission proved unsuccessful at intervals of less than one minute, an hour, and 24 hours. One experiment only proved successful ; a monkey became infected

as the result of six successive daily applications of numerous fresh flies which had just previously fed on an infected monkey.

(5) *Experiments with* Hippobosca maculata *in the Transmission of Surra.*

This fly is found upon all draught animals, especially on horses, during the whole year and it seems to attack equally well in darkened stables and in open pastures. As a rule it prefers to finish its protracted meal upon the same host. Twelve experiments in the direct method of feeding were pursued, using guinea-pigs for the most part; entirely negative results were obtained. A number of flies were next fed on an infected animal and applied to clean animals every day up to the 26th day, when there were only two survivors out of the original 33. Negative results again were obtained.

(6) *Experiments with Blood-sucking Gnats.*

Experiments with *Culicoides judicaudus*, in which some hundreds of flies were employed, both in direct and indirect transmission experiments, gave negative results.

Observations on a very common species of *Phlebotomus* likewise showed that this insect was incapable of transferring surra from infected to healthy animals.

(7) *The Role of* Musca domestica *in Surra Conveyance.*

The intimate relations existing between the feeding habits of *Stomoxys calcitrans* and the common house fly had been previously noted by the author. It was pointed out that the house fly acted in a sense as a secondary passive parasite by lapping to a point of engorgement the blood brought to the host's epidermis by the probing of the labium of the stable fly. It was first proved by means of numerous dissections and inoculation of saline suspensions of the abdominal contents into susceptible animals that *Musca domestica* could harbour infective organisms.

Attempts were made to simulate natural conditions by feeding large numbers of house flies on the blood of an infected animal and then allowing them to feed in conjunction with an equal number of clean Stomoxys on the tail of a clean monkey. The house flies then applied their mouth parts to the punctures made by the stable flies. Five experiments made after this manner gave negative results.

The possibility of surra infection being carried by the fly's feet was tested by repeating the preceding experiment, but in this case the flies were prevented from feeding and were only allowed to alight on the tail. Five experiments made in this way also failed to show that the wound made by the labium of the stable fly was a suitable channel for the introduction of trypanosomes.

It was further shown that the bites of the stable fly were not suitable sites for the introduction of trypanosomes by smearing fresh infective blood on a part that had just been bitten by Stomoxys.

House flies that had engorged on blood obtained from the bites of stable flies on infected animals were next allowed to feed on the abraded surface of the skin of three monkeys and two horses. It was found that positive results were obtained in four cases out of five.

NOELLER (W.). **Die Uebertragung des *Trypanosoma theileri*, Laveran, 1902.** [The Transmission of *Trypanosoma theileri* Laveran, 1902.]—*Berlin. Tierärztl. Woch.* 1916. Sept. 28. Vol. 32. No. 39. pp. 457–460. [Reprinted from the *Rev. Applied Entom.* 1917. Jan. Vol. 5. Ser. B. No. 1. p. 11.]

"The innocuous and easily bred *Trypanosoma theileri* probably occurs wherever domestic cattle are found and also among wild ruminants, such as antelopes. Its various forms have received different names. Knuth and Rauchbaar found flagellates in German TABANIDAE (*Tabanus* sp. ? and *Haematopota pluvialis*, L.), but could not prove their connection with this trypanosome. In 1903 Theiler considered the transmission of *T. theileri* to have been effected in South Africa by the Hippoboscids, *Hippobosca rufipes*, Olf., and *H. maculata*, Leach, but this cannot be held to be conclusive, as the possibility of transmission by other carriers, such as Tabanids and *Stomoxys* was not excluded. The scarcity of Hippoboscids on German cattle show that these flies cannot play an important rôle. It is far more probable that Tabanids are involved, as they harbour many flagellates. From available data the following list of Tabanids in which flagellates have been recorded has been compiled:—*Tabanus tergestinus* and *T. glaucopis* in southern France; *T. socius*, *T. par*, *T. ditaeniatus*, *T. fasciatus*, *T. africanus*, *T. gratus* and *T. virgatus* in Egypt; *T. hilarius* and *Tabanus* sp. in India; *T. secedens* and *T. thoracinus* in East Africa; *T. testaceomaculatus* in Chili; *T. congolensis* and *T. taeniola* in the Island of Principe. To these the author adds *T. bovinus* in Poland, and *T. bromius* in Brandenburg. Other records include *Pangonia infusca* and *P. nearei* in the Congo; *P. australis* in Chili; *Haematopota italica* in southern France; *H. pluvialis* in Germany; *H. duttoni* and *H. vandenbrandeni* in the Congo. All those observers of Tabanid flagellates who have studied the site where the flagellates occur in the bodies of the flies state this to be the walls of the hind-gut, though Bruce occasionally observed them in the fore-gut. The author's observations only relate to flagellates attached to the hind-gut, and the dissected Tabanids showed none in their stomachs, indicating that the infections were not recent ones. All observations relate to flagellates from the blood-sucking females, which attack cattle and horses by preference. Only a small percentage of these females are infected, and in wet, cold years the infection is absent in localities where it had previously occurred. In cattle-breeding districts the flagellates are common in Tabanids during hot summers. These observations pointed to a connection between the Tabanid flagellates and *T. theileri*. Among the ways in which the exact experimental proof of such connection could be reached was the one provided by the size and the characteristic shape of the giant culture forms of *T. theileri*. A full account is given of the experiment, which proved that the flagellates from *Tabanus glaucopis*, Meig., are the developmental stage of *T. theileri*. It is thought probable that other Tabanid flagellates also represent the developmental stage of this trypanosome. This experiment further proves that the transmission is not a simple mechanical one. A bibliography of 14 works closes this paper."

BOUET (G.). **Contribution à l'étude des zones à glossines du Sénégal (Région du chemin de fer de Thiès à Kayes).** [The Tsetse-Fly Belts of Senegal (Area traversed by the Thies-Kayes Railway Line).]—*Bull. Soc. Path. Exot.* 1916. Dec. Vol. 9. No. 10. pp. 802–813. With 1 map.

This paper forms an interesting contribution to the study of the fly belts and trypanosomiases of West Africa, the district particularly dealt with being that traversed by the projected railway connecting Senegal with the Sudan. This railway is about 700 kilometres in length between Thies, near the western coast of Africa, and Kayes on the Senegal River, and the first 400 kilometres are already under construction.

The intensive cultivation of earth-nuts has led to the gradual clearing of the first 300 kilometres but beyond the cultivated areas there exists a dense vegetation of trees and shrubs. The vegetation varies somewhat as the railway line penetrates into the interior of the country, becoming rather rare as it passes along the border of the Ferlo desert; then again afterwards up to the Falémé stream, at the 575th kilometre, the vegetation becomes thicker containing new species, especially bamboos. The railway tract is in no part crossed by a permanent watercourse.

Although the conditions of the country through which the railway passes seem everywhere favourable to the existence of *Glossina morsitans*, yet this fly is only found between the 440th and 575th kilometre. The railway runs, however, through almost the same latitude from west to east, that is, between 14° and 15° N.

In a previous communication the author and ROUBAUD showed that this line formed the northern boundary of a *morsitans* belt consisting of the whole of that part of Senegal known as Upper Gambia and that this belt coincided exactly with the distribution of the big game. The belt extends southwards over the Gambia River into Guinea territory up towards the line Kadé-Yambéring. Its western limits appear to pass through Kolda in the French Casamance territory and then pass north-eastwards, skirting round the borders of British Gambia. A small belt was also discovered by ROUBAUD in the district known as Niom Bato in the Kaolack region adjacent to fly belts described in the British colony north of the River Gambia. It is probable that this small *morsitans* belt was formerly united to the Upper Gambia belt, but that the inhabiting and cultivation of the intervening districts caused the big game to migrate towards the sparsely populated Upper Gambia.

Towards the east *Glossina morsitans* can be found along the right bank of the Falémé stream and southwards through the villages of Satadougou and Dougasita.

The zone inhabited by *Glossina morsitans* in this part of French West Africa thus occupies an important area characterised by the abundance of big game and sparsity of population. These fly belts are also characterised by the presence of a breed of small cattle known as the N'dama or Fouta Djalon breed, very resistant to trypanosomiases and the tsetse fly, and which, like the big game, play the rôle of reservoirs for the virus. As soon as these animals can be replaced by hybrids and by zebus one may be sure that the tsetse fly does not exist in the district. The tsetse fly limits the extension southwards of the zebu in West Africa and makes it hardly possible to maintain the existence of hybrids.

A study of this region was undertaken by the author, at the request of the Government of French West Africa, on account of the heavy mortality among the caravan animals, especially the oxen, which brought food to the railway workers from the Sudan and from Upper Senegal and Nigeria.

The author then records the incidence of *Glossina morsitans* along a caravan tract constructed at a short distance from the railway line, commencing at Synthiou Coulé at the 440th kilometre; the last Glossina were captured at Naïes near the Falémé stream (575th kilometre). These fly catchings took place in September and October.

The number of females was insignificant compared with the number of males (three females for 75 males at one place on the 1st October), and thus it was thought that reproduction must take place at some other time of the year. According to the natives the flies disappear more or less completely during the dry season [*hivernage*] and only commence to reappear towards the end of September. They are especially abundant during the colder months (January, February and March), and their number diminishes as soon as the hot weather preceding the dry season is felt. Owing to the complete absence of permanent watercourses, except for a few wells which remain during the rainy season and become quickly dried up during the dry season, the conditions are such that no flies of the species *Glossina palpalis* are found in all this region.

Animal trypanosomiases. Experiments were made in order to determine whether the flies of the districts examined were infected and which trypanosomes they were capable of transmitting. A young sucking kid taken from a tsetse-free area was bitten from the 5th to the 23rd October with 88 *Glossina morsitans* captured in three villages. On the 24th October trypanosomes of the species *T. dimorphon* appeared in the blood and the goat died on the 21st November.

T. dimorphon has already been discovered in Upper Gambia and the disease caused by it is thus shown to extend further northwards. In these villages very few horses are found, these belonging to the chiefs only, who are obliged to replace them frequently. The work of railway construction had not penetrated into the fly area and thus out of about 50 horses and mules employed on the work only one was found infected. As the work proceeds there is no doubt that tsetse fly will cause a very considerable losses among horses.

As a rule horses do not survive for longer than one year in this area and care is then taken to keep them within the inhabited areas. Numbers of cattle of the N'dama breed in very good condition were seen in the tsetse area. In other villages just outside the area a certain number of various cross-breds were seen but very few of these could be found within the borders of the fly area.

In one village within the fly area examination of 100 cattle, 5 asses, 7 sheep, and 14 goats was negative. The sheep and goats belonged to the Fouta-Djalon (a southern) breed. According to the natives sheep and goats imported from Morocco die in from two to three months after their arrival in the country. Two out of three dogs of the village showed *T. dimorphon*; dogs appear to be very susceptible to this trypanosomiasis, and according to the natives they all die.

Outside the fly area blood examinations were also made of the various animals, the cattle for the most part being cross-breds and very rare cases of trypanosomiases were found. On the borders, trypanosomes were commonly encountered, especially in cross-bred cattle, sheep, and goats.

The author concludes that the Glossina of this area like those of the Upper Gambia area seem only capable of transmitting the trypanosomiasis due to *T. dimorphon*, and that at the present moment they are free from the other animal trypanosomes, *T. pecaudi* and *T. cazalboui*, of West Africa. It is feared that the passage to the Cold Storage Meat Factory now situated near the coast of Senegal of numerous herds of zebus, in particular from the Sudanese regions, may introduce

into the Thies-Kayes area these other two viruses which *Glossina morsitans* is capable of transmitting. Inversely, the clean Sudanese herds passing through this area will become contaminated with *T. dimorphon*, but, as the majority of these animals are destined for slaughter the mortality from this disease will be very small, but infection will certainly be very large. The completion of the railway line will modify this state of affairs if care is taken to place the cattle in screened trucks as has been done on the Ivory Coast railway line.

The changes brought about by the migration of population along the railway line for the cultivation of earth-nuts will gradually cause the disappearance from this area of big game and, consequently, also of *Glossina morsitans*.

MACFIE (J. W. Scott). **The Results of Dissections of Tsetse Flies at Accra.**—*Report of the Accra Laboratory for the Year 1915.* pp. 49–54. With 1 plate. 2 tables and 4 text figs. 1916. London, W: J. & A. Churchill.

Examination of tsetse flies caught in the neighbourhood of Accra was undertaken on account of the great frequency of trypanosomiasis in cattle brought to Accra for slaughter. The flies were fed on various experimental animals and were dissected after having been confined for about three weeks, or at death if this happened earlier.

The following table shows the distribution of infection in the two species of flies caught.

Species of Tsetse Fly.	Number dissected.	Negative.	Spirochaetes in gut.	Sporocysts in abdomen.	Fungal infection.	Trypanosome Infections.				
						Proboscis, gut and salivary glands.	Gut and salivary glands.	Proboscis and gut.	Proboscis only.	Gut only.
G. palpalis ..	75	63	1	2	1	—	3	1	3	4
G. longipalpis ..	8	7	—	—	—	—	—	—	1	—
	83	70	1	2	1	—	3	1	4	4

"*Trypanosome infections.*—Morphologically the flagellates found in nine of the flies were of a pathogenic type, viz., those present in four infections of the proboscis, three of the gut and salivary glands, and two of the gut only. Three flies showed flagellates of the *T. grayi* type in the gut, and these parasites when alive were extremely active and were easily distinguished from the pathogenic types by this fact and by the extreme slenderness of their bodies. When fixed and stained they were seen to include both crithidial and trypanosome forms. The nucleus was large, oval, and situated towards the posterior end of the body; and the micronucleus was large and rod-shaped and was placed near the nucleus, sometimes being anterior to it, sometimes posterior. Two of the flies infected with flagellates of the *T. grayi* type had also a sporocyst infection of the abdominal cavity.

"With regard to the infections with flagellates of the pathogenic type it is difficult to decide what trypanosomes they represented in the absence of

positive results from feeding and inoculation experiments. The common trypanosomes at Accra are *T. pecaudi* (*T. brucei* of Uganda), *T. vivax*, and *T. congolense*, and sleeping sickness is not known to occur at Weshiang where the tsetse flies were caught. It is probable therefore that all the infections of the proboscis were *T. vivax*, although three of the flies had been repeatedly fed on a goat without infecting it. The infections of the gut and salivary glands were possibly *T. pecaudi* (*T. brucei* of Uganda), and so were also perhaps the two infections with flagellates of a pathogenic type of the gut only. It must be remembered, however, that according to ROUBAUD *T. pecaudi* develops in the gut and proboscis, and not in the gut and salivary glands. None of the infections resembled stages of the development of *T. congolense*."

Other infections.—These consisted in the discovery of spirochaetes, a fungal infection, and sporocysts in specimens of *Glossina palpalis*; an interesting and minute description, illustrated with figures, is given of the two latter conditions.

OFFERMANN. **Ueber die serologischen Untersuchungsmethoden als Hilfsmittel zum Nachweis der Trypanosomenkrankheiten, im besonderen der Beschaelseuche.** [Serological Tests in the Diagnosis of Trypanosomiasis, especially in Dourine.]—*Arbeit. a. d. Kaiserl. Gesundh.* 1915. Sept. Vol. 50. No. 1. pp. 1–29. With 25 tables.

In this paper a series of experiments is described which were performed with the object of ascertaining the value of the complement and agglutination tests in the diagnosis of trypanosomiasis. The tests were performed on a dozen healthy rabbits which were inoculated at various times with certain quantities of the blood of dourine-infected guinea-pigs when trypanosomes were most abundant in their blood.

A full description of the technique employed in the complement test is given. All the rabbits were tested beforehand in order to determine the quantity of serum required to prevent haemolysis in the haemolytic system before infection. The antigen consisted of an extract of the trypanosomes obtained in a pure state from the blood of dourine-infected rats just before death by repeated washing and centrifuging. All the elements entering into the haemolytic system were carefully titrated beforehand and a full set of the necessary controls was utilised in each test. The stored serum of the rabbit before infection also entered into each series. A microscopic examination of the blood was made daily after infection together with the inoculation of mice in order to determine the first appearance of trypanosomes in the blood. Blood to be used in connection with the complement test was taken from a vein every two to six days after the first four or five days.

For the agglutination test, serum was procured from the rabbits in the same way, and the emulsion consisted of a suspension of trypanosomes obtained in the same manner as for the complement test. The serum was added in the required dilutions, the mixture allowed to remain in the incubator at 37° C. for five hours, and the results were then read off. The agglutination titer on the various dates on which serum was taken is given.

The clinical history is described in the case of each animal.

The author's general conclusions with regard to both these tests are as follows:—

"(1) Sera obtained from healthy rabbits possessed in many cases an inhibitory effect upon haemolysis.

"(2) A regularity in the appearance of the bodies causing the inhibition cannot be determined. While many sera proved very strongly inhibitory, in others this property was completely or almost completely absent.

"(3) In no case in the tests performed could an inhibitory action be observed following the use of 0·01 cc. or a smaller quantity of normal rabbit serum.

"(4) When the serum of a rabbit is to be used in researches in connection with the complement test the serum should be tested before infection.

"(5) No agglutinins causing agglutination of the trypanosomes of dourine could be discovered in normal rabbits.

"(6) In the serum of dourine-infected rabbits complement-binding anti-bodies and agglutinins could be discovered.

"(7) The anti-bodies did not always appear simultaneously. Generally, complement-binding amboceptors appeared earlier than agglutinins. While the first-named were traced as a rule 8–9 days after artificial infection, the latter took 12–13 days to appear.

"(8) The anti-bodies appeared later than the trypanosomes in the blood. The complement-binding amboceptors were traced 4–9 days, and the agglutinins 4–22 days, later.

"(9) The appearance of anti-bodies varied in time and quantity according to the individual animals and the course of the disease. The anti-bodies often decreased during the course of the disease, only to increase again towards the end. A regularity in the appearance of these phenomena could not be determined. In no case did they disappear altogether from the blood.

"(10) By storing the serum with sterile precautions the anti-bodies could be discovered after many months.

"(11) For the agglutination test fresh trypanosome emulsions must be used as they lose their activity when stored.

"(12) The antigens obtained from the trypanosome emulsions for the complement test retained their activity for many weeks when stored in an ice chest.

"(13) The complement and agglutination tests are useful diagnostic methods, as well as the inoculation of blood into white mice.

"(14) As the complement test gives better results than the agglutination test it is to be preferred for diagnosis."

MACFIE (J. W. Scott). **A Trypanosome of the Black Rat.**—*Report of the Accra Laboratory for the Year 1915.* pp. 72–73. With 1 coloured plate comprising 10 figs. 1916. London, W.: J. & A. Churchill.

The author describes polymorphic trypanosomes of the *T. lewisi* type found in immense numbers in the blood of a young black rat (*Epimys rattus*). The longest measured 48μ, the shortest 15μ, average 30·02μ. In breadth they averaged 2·6μ and ranged from 2μ to 6μ. Four types of parasite could be distinguished with intermediate stages between them.

The majority were about 30 to 35μ in length and 2μ in breadth, possessed a well-marked free flagellum, and the posterior extremity was prolonged for a considerable distance beyond the micronucleus.

Very much smaller trypanosomes, some of which measured only 12μ in length were fairly common and in them the posterior end tapered rapidly into a finely pointed cone, and the micronucleus was not infrequently situated alongside of or even slightly anterior to the macronucleus.

Larger broad forms measuring 6 microns at their widest part were also seen.

These three types were very similar to those described by DELANOË (1915) as typical of *T. eburneense*, the first type representing the adult and the other two the multiplicative forms.

In addition, there were some remarkable forms with the posterior end prolonged into a whip-like extension sometimes about 24μ in length. These trypanosomes measured up to 52μ in length and 3 or 4μ in breadth. Intermediate forms were found which seemed to link this type with the commonest form of trypanosome present in the blood. Similar forms were found by LINGARD (1906) in rats. The name *T. longocaudense* was originally proposed for them, but subsequent observations have proved them to be forms of *T. lewisi* which are of "constant occurrence and very numerous at a certain stage of the multiplication period" (MINCHIN, 1912).

VAN SACEGHEM (R.) & NICOLAS (E.). **L'émétique dans le traitement des trypansomiases.** [Tartar Emetic in the Treatment of Trypanosomiases.]—*Bull. Soc. Path. Exot.* 1916. Dec. Vol. 9. No. 10. pp. 813–823.

Reference is made to the researches of PLIMMER and THOMSON and other workers on the use of ordinary tartar emetic, potassium acid antimony tartrate, and its efficacy in the treatment of trypanosomiasis. Mention is also made of the curative results obtained by Van Saceghem in the treatment of all bovines infected with *T. cazalboui* in the Belgian Congo. A therapeutic dose (6 mg. per kilog.), administered subcutaneously, causes the disappearance of trypanosomes in eleven minutes from the peripheral circulation of guinea-pigs infected with *T. ugandae* and *congolense*.

In view of this rapid disappearance of trypanosomes from the peripheral blood following treatment, the question arises as to where the trypanosomes which bring about relapses originate. It appears impossible that there remain forms in the blood capable of resisting the drug because no such forms have been demonstrated by any observer, and if these existed the blood would remain infective which, however, is not the case in animals that have just been treated; also, if the inoculation of trypanosomes into a susceptible animal is combined with the injection of a therapeutic dose of tartar emetic infection is prevented.

One must thus admit that if no trypanosome escapes the action of the drug in the peripheral circulation there are organisms disseminated in various parts of the body, separated from this circulation, and not submitted to its action.

The serum of guinea-pigs which have received a fatal dose of the drug has no trypanocide action in vitro. The drug therefore disappears quickly from the circulation, or else it becomes rapidly transformed locally, or becomes excreted. Its short stay in the peripheral circulation is, however, sufficient to enable it to exterminate all the organisms which multiply in the blood but its "penetrating" action is too small to enable it to reach the trypanosomes hidden in the deeper tissue channels. These trypanosomes serve as the strain which re-infects the peripheral circulation after the necessary period of incubation. It may be that the multiplication of the trypanosomes is also retarded by the formation of antibodies.

When the serum (e.g., of a horse) is added drop by drop to 10 cc. of a saturated solution of tartar emetic an abundant albuminous precipitate is formed which becomes dissolved in a slight excess of serum

as well as in alkalis or alkali carbonates. This precipitate does not appear in solutions of antimony tartrate to which common salt has previously been added, or in very dilute solutions. In intermediate concentrations it is replaced by a more or less marked turbidity.

An abundant precipitate is formed if one adds to the mixture of serum and tartar emetic an acid solution (e.g., of tartaric acid), in an excess of which it is not soluble. It thus seems that the alkalinity of the serum when present in sufficient quantity prevents precipitation.

The blood serum, the alkalinity of which is especially due to $NaH\,CO_3$ and $Na_2\,H\,PO_4$, first of all neutralises the acidity of the tartar emetic and then if present in sufficient quantity causes the appearance of another white, powdery, very fine precipitate composed of a mixture of calcium tartrate and antimony oxide. This precipitation is sometimes slow in appearing.

Experiments in vivo.—If a mixture of equal quantities of a 2 per cent. solution of tartar emetic and horse serum is injected into a mouse it is found that the trypanocide action of the drug is retarded.

It was also found that the addition of serum to the drug diminishes its irritant action in the connective tissue.

The white antimony precipitate, which excess of serum forms in a solution of tartar emetic, injected after washing and centrifugation into a trypanosome-infected mouse, does not possess any direct trypanocide action capable of manifesting itself after a relatively brief interval.

Tartaric acid has no trypanocide action *in vivo*. The administration of 0·01 gramme of tartaric acid into a mouse infected with nagana has an inhibitive effect on the action of a therapeutic dose of tartar emetic. This acid becomes transformed into sodium tartrate in the blood and it has no trypanocide properties, but impedes the action of the emetic.

Hydrochloric acid, at 1 per cent., has no trypanocide action.

Sodium bicarbonate and carbonate markedly diminish the toxicity of tartar emetic.

Experiments in vitro.—Sodium bi-carbonate and carbonate in isotonic solutions have no action on trypanosomes. Solutions of these substances added to a solution of tartar emetic diminish its trypanocide properties.

Tartaric acid used in a 2 per cent. solution has a marked trypanocide action. Previous neutralisation with sodium carbonate prevents this action.

It appears from this result that it is the SbO group of tartar emetic which has the trypanocide property since the tartaric radicle taken separately is, after neutralisation, devoid of all harmful effect on the trypanosomes; it, however, has advantages in that it presents the antimony in a form soluble and stable in the presence of water, easily diffusible and capable of acting more rapidly and more energetically than other forms on the parasites it comes into contact with.

Administration of tartar emetic.—Subcutaneously, the drug produces a considerable swelling and often sloughing but intravenous injections of watery solutions are well supported by man and the lower animals.

Van Saceghem introduced the method of administering the drug into the deep muscle tissues of the neck, after which no abscess formation took place. The drug is held in as fine a suspension as possible in an oily-fatty medium (olive oil or the liquid portion of horse fat

or in liquid paraffin in order to diminish its irritant effect on the connective tissue. Camphor, which can be dissolved in the oil, further diminishes the irritant effect on account of its sedative properties. The addition of 5 per cent., for example, of horse serum also causes it to lose in part its irritating properties. These oily camphorated suspensions of the drug are well tolerated after intravenous injection.

By retarding the diffusion of the drug in the blood these suspensions should diminish the toxicity of the substance, and thus allow of larger doses being employed and prolong the duration of its action.

Treatment of trypanosomiasis.—Tartar emetic kills *T. cazalboui* in vitro in solutions of 1/20,000. In the treatment of trypanosomiasis due to *T. cazalboui*, *congolense*, *evansi*, and *equiperdum* (mouse), almost uniformly successful results have been obtained, but in the case of other trypanosomes, such as *T. brucei*, *gambiense*, and *equinum* (mouse), the results are not consistent. The authors believe that failures in the case of the latter trypanosomes are due to their residing in the deeper tissue spaces of the body which are not reached by the drug. The affections produced by trypanosomes transmitted mechanically and hence requiring their presence in large numbers in the blood, hardly ever resist the therapeutic action of the drug. Van Saceghem has thus shown that bovines affected with *T. cazalboui* can be cured by means of a single intramuscular injection of a medicinal dose of tartar emetic.

The various methods of administration are dealt with as follows :—

Large doses dissolved in water are very toxic producing a general depressant action, especially on the heart.

Administration in oily suspensions prevents rapid diffusion and allows of a widespread action of the drug and of larger doses being used. The addition of camphor to the oil has moreover a considerable cardiac tonic effect.

The emulsion is made up as follows :—The tartar emetic is ground up in a mortar as finely as possible and then mixed with some oil into a homogeneous mixture. It is then poured into a flask containing some glass beads and sterilised in a water bath or, if possible, in an autoclave at 110° C. for 15 minutes. After cooling the desired quantity of camphor (10 to 20 per cent.), previously dissolved in a little ether, is added. Before use, the mixture is well shaken up and here the glass beads assist in emulsification.

Subcutaneously, a dose of from 4 to 6 mg. of tartar emetic per kilog. is employed in the case of the large animals and the desired amount is made up to 100 cc. with camphorated oil.

Administered by the mouth the drug has no effect.

Intravenous administration is very effective and the dose given is from 1 to 2 grammes, in the case of the large animals, dissolved in physiological salt solution. Broden and Rodhain have shown that fewer cures are obtained by intravenous than by subcutaneous administration. The authors recommend the introduction intravenously of the drug in an oily camphorated solution as it is thus very well tolerated by animals.

Administered intramuscularly in a dose of 6 mg. per kilog. in 50 cc. of salt solution, the local reaction is *nil* or transient. When administered according to the technique described by the authors no abscess formation ever takes place, and only a small fibrous thickening is left

at the seat of injection. The oily suspensions are well suited for this mode of administration and one would employ two grammes of tartar emetic in 100 cc. of camphorated oil.

(g) Miscellaneous.

Low (G. C.). **The History of the Use of the Intravenous Injections of Tartar Emetic (Antimonium Tartaratum) in Tropical Medicine.**—*Trans. Soc. Trop. Med. & Hyg.* 1916. Dec. Vol. 10. No. 2. pp. 37–42.

The credit for first proposing the use of antimony salts in tropical medicine, viz., in trypanosomiasis, is given to Nicolle and Mesnil (1906) who were led to suggest it on account of the unsatisfactory results obtained with atoxyl and other arsenic compounds. Reference is also made to the successful results obtained by Plimmer and Thomson in 1907 in the treatment of experimental trypanosomiasis.

Broden and Rodhain (1906 to 1908) first tried the effect of administering large doses intravenously to natives suffering from sleeping sickness.

In the treatment of leishmaniasis the first records of the use of tartar emetic injections were made in 1913, when Machado and Vianna successfully treated cases in this manner in Brazil. In the same year Aragao and Vianna treated cases of ulcerating granuloma of the human subject by the same method with excellent results. Further details with regard to the treatment of these diseases by this method are given, together with a list of published papers.

A history of the treatment of trypanosomiasis of the domesticated animals by this method has, unfortunately, been omitted.

Castellani (Aldo). **The Treatment of Certain Diseases of Protozoal Origin by Tartar Emetic, Alone and ih Combination.**—*Brit. Med. Jl.* 1916. Oct. 21. pp. 552–553.

Although this article deals exclusively with the treatment of human diseases, a study of the methods employed and the results obtained will undoubtedly be of value in so far as they indicate comparable lines of treatment which might be adopted in the diseases of protozoan origin of the domesticated animals.

"Tartar emetic is of great efficacy in various protozoal diseases. Its powerful action in trypanosomiasis has been well proved, and it can be used as a specific in espundia, granuloma inguinale, kala-azar, and oriental sore. It is efficacious in yaws, especially if combined with other drugs, and seems to have a beneficial action also in relapsing fever."

Various formulae are given, in which tartar emetic constitutes the active ingredient, for oral, intravenous, and intramuscular administration in the diseases enumerated.

Intramuscular injections are stated to be extremely convenient, but the usual solutions of tartar emetic are very painful when given in this way and may induce the formation of an abscess. The following represents one of the formulae devised with the object of eliminating this irritant action:—Tartar emetic, 8 grains; carbolic acid, 10 minims; glycerine, 3 drachms; sod. bicarb., ⅓rd grain; distilled water, up to

1 oz. In the case of the human subject affected with kala azar ½ to 1 cc. of this mixture is injected intramuscularly every other day in the gluteal region.

MACFIE (J. W. Scott). **Bodies Resembling *Paraplasma flavigenum* in Men and Animals.**—*Report of the Accra Laboratory for the Year 1915.* pp. 58–63. With 2 plates (1 coloured) comprising 11 figs. and 1 chart. 1916. London, W: J. & A. Churchill.

In this paper the author refers to SEIDELIN's discovery (1911–1912) in Mexico of *Paraplasma flavigenum* in the red corpuscles of a few human subjects who presented no symptoms of yellow fever, and were considered to be pseudo-carriers of the disease.

The history is given of a disease characterised by fever and debility affecting a European and a native, respectively, in West Africa; the cause of the disease could not be determined but bodies resembling *Paraplasma flavigenum* were found in blood films.

The author discusses the etiological significance of *Paraplasma flavigenum* in yellow fever. The occurrence of similar bodies in guinea-pigs after inoculation with the blood of patients suffering from yellow fever at Lagos in 1913 was discovered by the author and JOHNSTON, but at that time none could be found in the blood of clean guinea-pigs. Subsequently the author found Paraplasma-like bodies in uninoculated guinea-pigs. CONNAL and JOHNSTON (1915) found red-cell inclusions resembling *Paraplasma flavigenum* in nearly 26·5 per cent. of the guinea-pigs they examined at Lagos.

WENYON and LOW (1914) also observed these bodies in guinea-pigs and accordingly attempted to disprove the parasitic nature of *Paraplasma flavigenum* and to discredit the experiments in which these bodies appeared to have been transmitted by inoculations.

In CONNAL and JOHNSTON's experiments the guinea-pigs found to harbour Paraplasma-like bodies after inoculation with yellow fever blood did not in any single case show them before the experiments were begun.

When guinea-pigs were inoculated with normal human blood they found that the pyrexia "was comparatively slight, and the charts differ distinctly from those which recorded the temperature of yellow fever guinea-pigs."

MACFIE (J. W. Scott). **A Further Note on a Disease of Fowls characterised by Inclusions in the Leucocytes.**—*Report of the Accra Laboratory for the Year 1915.* pp. 68–70. With 1 chart. 1916. London, W: J. & A. Churchill.

In this short article, the author describes a fatal disease in a turkey in which inclusions were found in the leucocytes similar to those described by him in 1914 in an outbreak of disease among fowls at Eket in Nigeria [see this *Bulletin*, Vol. 3, No. 1, p. 27].

During life the turkey showed symptoms of marked depression and slight diarrhoea; on examining the blood a few pigmented parasites of the Halteridium type were found in the red blood corpuscles, and a few of the leucocytes contained inclusions. Treatment by means of

atoxyl proved unsuccessful and the turkey died on the 4th day; post-mortem examination revealed no gross lesions; the tissues were not anaemic, and the liver and spleen were enlarged.

0·5 cc. of the blood was inoculated subcutaneously into a fowl. Inclusions were found in its leucocytes on the fourth day, and fever and other symptoms afterwards set in. The bird died on the 10th day. The liver and spleen were both enlarged, and inclusions were found in the latter organ similar to those found in the turkey.

Another fowl inoculated subcutaneously with the heart blood of this fowl also developed symptoms of illness on the fourth day, and later a high temperature together with a few inclusions in its leucocytes. By the 11th day it had apparently recovered from the infection, but it did not regain its normal condition until many weeks later.

Two chickens inoculated with blood from this second fowl on the 6th day did not become infected.

The disease in the turkey thus appeared to be not so virulent as that observed in the case of the Eket fowls.

BAYON (H.). **The Development of Pathogenic Properties in Protozoa, with Special Reference to the Herpetomonad Group.**—*Trans. Soc. Trop. Med. & Hyg.* 1916. Dec. Vol. 10. No. 2. pp. 23–32.

This is a purely theoretical paper dealing with the probable evolution of pathogenic properties in protozoa in the light of recent advances in our knowledge of the developmental cycles and incidence of certain protozoa which cause disease in man and other vertebrates. Protozoa of medical interest are tabulated according to their mode of life and pathogenicity. The author classifies spirochaetes in the same manner as FANTHAM who states "that spirochaetes are intermediate in character between bacteria and protozoa, showing morphological affinities with bacteria and physiological and therapeutical (biological) affinities to protozoa."

The principal features and properties of protozoa capable of causing disease in man and other animals are reviewed, and from this classification the author claims to show "that the parasitic protozoa which have the most marked pathogenic properties for man and mammals are those which, as a rule, can be definitely distinguished morphologically from their saprozoic harmless relations." He excludes from this rule the Herpetomonad group. "The pathogenic, even lethal properties of *Leishmania donovani*, and the extreme similarity of its herpetomonad stage to saprozoic races, are a definite and glaring exception to this rule which requires separate attention and expanation."

In discussing the trypanosome group the author concludes that in the case of trypanosomes of great virulence such as *T. rhodesiense, gambiense, evansi, brucei*, etc., the adaptation to a certain form of parasitic life has become so permanent that a reversion to simpler forms is no longer possible. "On the other hand *T. lewisi* with all its mild pathogenic properties adapts itself easily to varying conditions (cultural, etc.), and in so doing repeats its ontogenetical development in a somewhat similar fashion to what has been observed in the embryonal stages of vertebrate life."

In dealing with the herpetomonads the author refers to the experiments of FANTHAM and PORTER, and quotes their conclusions *in extenso* (see this *Bulletin*, Vol. 4, pp. 23 and 146).

He also refers to his own discovery of herpetomonads in the cloaca of *Chamaeleon pumilus* at Robben Island in 1913. He concludes that in the case of diseases such as kala azar "it is quite possible that this group of diseases is acquired by the inoculation through blood-sucking insects of apparently free-living or saprozoic varieties."

A discussion of the behaviour of the pathogenic spirochaetes and amoebae concludes the paper.

DISEASES DUE TO METAZOAN PARASITES.

ROUBAUD (E.). **Les Porcins et la conservation des Ectoparasites humains, dans les régions chaudes.** [The Rôle of Pigs in the Maintenance of Human Ectoparasites in the Tropics.]—*Bull. Soc. Path. Exot.* 1916. Dec. Vol. 9. No. 10. pp. 768–771.

In the course of his researches on the Auchmeromyia the author noted a striking relationship between these blood-sucking larvae found on man and those found on two species of animals (Phacochoerus; Orycteropus)* that are very common in Tropical Africa, live in burrows, and possess a hairless skin. The Cheromyia larva found in the burrows of Phacochoerus and the human Auchmeromyia larva commonly known as the "Congo floor maggot" (*ver des cases*) found on negroes are strictly related inasmuch as both types can be reared experimentally on the pig or on man. It thus appears that, depending on the prevailing conditions, a substitution may take place between the hosts.

The author enumerates a series of ectoparasites which have been established as capable of living on animals or on man. Examples of these are the human tick, *Ornithodorus moubata*, the vector of "tick fever," found by LLOYD in Rhodesia in the burrows of Phacochoerus in uninhabited districts; WELLMAN in Angola and VAN SACEGHEM in the Belgian Congo have also found this tick in the styes of domestic pigs.

The chigger flea of man, *Sarcopsylla penetrans* L., known in Brazil as the *bicho de porco*, was found by VAN SACEGHEM at Zambi in such abundance on pigs as to form veritable walls around the feet, mammary glands, and scrotum.

With regard to biting flies it is stated that in the Island of Principe the tsetse fly best adapted to man, *Glossina palpalis*, is also the common fly found on wild pigs. The Portuguese Commission on Sleeping Sickness found that the distribution of the *palpalis* in the Island corresponded exactly with the migrations of large bands of half-wild pigs. The extermination of these pigs rapidly brought about the disappearance of these insects.

The mange sarcopt of the pig is easily transmissible to man, whereas it has no other hosts; the goat sarcopt is transmissible to both man

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* "Phacochoerus is the wart hog, an African genus of pigs (Suidae). Orycteropus has nothing to do with the pig-family, although superficially like a pig. It is an anteater usually classified in the Edentata."—R. J. POCOCK, F.R.S., F.L.S.

and the pig. NOELLER, working recently on the transmission of typhus, found that the pig louse remains a long time alive on man and inversely the louse of human clothes may remain alive for seven days or longer on the pig.

From these data the author concludes that pigs show themselves to be the animals most nearly related to man as far as the possibilities of the nutrition of ectoparasites are concerned.

ROUBAUD (E.) & VAN SACEGHEM (R.). **Observations sur quelques insectes et acariens parasites du bétail au Congo Belge.** [Some Insect and Acarian Parasites of Cattle in the Belgian Congo.]—*Bull. Soc. Path. Exot.* 1916. Dec. Vol. 9. No. 10. pp. 763–767.

These observations were made at the Veterinary Establishment at Zambi, in a country where until recently stockbreeding had never existed.

(1) *Larvae producing animal myiases in the Lower Congo.*

(*a*) Bot Oestridae.—In the digestive tract of an elephant killed in the Kassai district were found two species of Cobboldia larvae in their third stage. One of these was identified as *Cobboldia loxodontis* Brauer, and the other corresponded with a species recently described by RODHAIN and BEQUAERT under the name of *C. chrysidiformis*.

In the stomach of asses of the Lombardy and Poitou breeds introduced in 1911 larvae corresponding to the type *Gastrophilus intestinalis* of Europe were found. The rearing of some of these produced adults very similar to the form *G. asininus* identified by BRAUER.

It is interesting to note that these parasites are the result of an external importation and local acclimatisation of the species. Originally there were no bots in the Lower Congo on account of the absence of equines, the first animals capable of harbouring these parasites having been brought from Senegal in 1911.

No warble Oestridae were observed on domestic animals or on the wild mammals.

(*b*) Muscidae.—Myiasis due to *Chrysomyia* (*Pycnosoma*) *bezzianum* Vill. (=*megacephala* Bezzi) is frequent among the bovines of the station. Hitherto this myiasis has only been observed in the case of the large domesticated animals,—cattle and horses. It is found also at Zambi on pigs, especially about the ears and scrotum. It was also found on a young domesticated antelope and thus it is probable that the myiasis actually occurs among wild mammals. Cases of the disease always appear as wound complications.

Myiasis due to *Lucilia argyrocephala* Macq., which has hitherto only been found in mammals including man, appears also very widespread among birds. The adult flies of this species were obtained by rearing larvae collected from the wounds of a Barbary duck. Larvae corresponding exactly with the same species were obtained on a fowl. Also pupae collected in the nest of a Tisserins bird (*Ploceus collaris*) developed into the same species of Lucilia. In these nests were also found pupae of *Passeromyia heterochaeta* Vill., a muscid blood-sucking larva of Congo birds, the life-history of which has been described by RODHAIN and BEQUAERT. It appears that the myiasis due to *L. argyrocephala* in birds is consequent upon the antecedent parasitic action of the blood-sucking larvae of Passeromyia; the multiple cutaneous

erosions produced by the bites of these larvae and the lesions resulting from scratching in the young birds appear to constitute a port of entry for the parasite producing the myiasis.

(2) *Biting flies and acari on cattle at Zambi.*

Tabanidae.—*Haematopota perturbans* Edw. [see this *Bulletin*, Vol. 4, No. 4, p. 159 for probable rôle in the transmission of *Trypanosoma cazalboui*], *Tabanus canus* Karsch, *T. ditoeniatus* Macq., *T. pluto* Walk., *T. par* Walk., *T. biguttatus* Walk., *T. taeniola* P. B.

Stomoxydae.—*St. calcitrans* and *Lyperosia pallidipes* Roub. are very common on cattle.

Hippoboscidae.—None have yet been observed in spite of the importation of equines.

Pulicidae.—The chigger flea of man, *Sarcopsylla penetrans* L., infests pigs in such large quantities that it forms a veritable obstacle to breeding. The wounds it produces may become gangrenous. The feet, scrotum, and the mammary glands of sows are the parts most often affected. The chigger of fowls, *S. gallinacea* West., is frequent around the eyes of poultry, and it may also infect domesticated cats.

Pediculidae.—*Haematopinus suis* L., is found in abundance on native and imported pigs; on cattle *H. eurysternus* Nitzsch. has been observed around the eyes. *H. tuberculatus* Grib. var. *penicillatus* was found on a buffalo imported from Italy.

Acarinae.—Psoroptic otacariasis is fairly widespread. This disease is also observed in the sheep with the same characters as in the case of the goat; the conchal cartilage is filled with greyish-yellow, compact, very irregularly shaped crusts in which the parasites are found. The morphological characters of the parasites observed in the case of the goat and in the sheep are the same.

Among domesticated rabbits auricular psoroptic mange is also very common, and is of European origin. Likewise *Dermanyssus gallinae* and *Cnemidocoptes mutans* are very common on poultry, and *Chorioptes equi* Her., the cause of symbiotic mange in the horse, is always found among the equines of the station.

Among the Ixodidae collected at Zambi on animals the authors have been able to identify *Rhipicephalus appendiculatus* Neumann, *Rh. simus* Koch, *Rh. capensis* Koch, *Amblyomma variegatum* Fabr. and *splendidum* Giebel, and *Margaropus annulatus* Say, and on an elephant from Kassai, *Amblyomma tholloni* Neumann. Also, in the piggeries in the district of Paso-Kondé the human tick *Ornithodorus moubata* was observed in great abundance in the rotten wood of the pigstys. Relapsing fever has not been discovered in the district and Argas is unknown to the natives. The examination of some Ornithodorus for spirilla proved negative. This was the only district in which these Argasidae were found.

MORSTATT (H.). **Bestimmungsschlüssel der in Deutsch-Ostafrika bekannten Tsetsearten.** [The Tsetse Flies of German East Africa.]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1914. Aug. 2. Vol. 18. No. 16. pp. 574–575.

A description is given of the external diagnostic characters of the tsetse flies in German East Africa, viz., *Glossina palpalis* R. D., *Gl. austeni* (*tachinoides*) Newst., *Gl. morsitans* Westw., *Gl. pallidipes* Aust., *Gl. brevipalpis* (*fusca*, *tabaniformis*) Newst.

GLAESER (Hans). **Bestimmungsschlüssel der in Kamerun und Togo bekannten Tsetsearten.** [The Tsetse Flies of the Cameroons and Togoland.]—*Arch. f. Schiffs- u. Trop.-Hyg.* 1914. Aug. 2. Vol. 18. No. 16. pp. 571–573.

The external diagnostic features are given of the known tsetse flies of these countries.

Cameroons.—*Glossina ziemanni* Grünb., *Gl. tachinoides* Westw., *Gl. caliginea* Aust., *Gl. palpalis* Rob-Desv., *Gl. pallicera* Big., *Gl. tabaniformis* Westw.

Togoland.—*Gl. palpalis* Rob-Desv., *Gl. longipalpis* Wied., *Gl. morsitans* Westw., *Gl. fusca* Walk.

*VEGLIA (F.). **The Anatomy and Life-History of** *Haemonchus* (*Strongylus*) *contortus* (Rud.).—*Union of South Africa. Third & Fourth Reports of Director of Veterinary Research.* 1915. Nov. pp. 347–500. Extracted in the *Jl. Comp. Path. & Therap.* 1916. Sept. Vol. 29. No. 3. pp. 265–277.

Free Life.

The Egg.—Eggs were obtained for examination and for cultural purposes by making a decoction of faeces, passing through a sieve, repeatedly sedimenting the liquid and centrifuging the sediment, from which the eggs were collected by means of a pipette. The egg is oval and measures on an average 70·9 by 45·9μ and when laid by the female is mostly found to be in the four-cell stage. In the stomach of the host eggs at the 6-, 7- and 11-cell stages may be found, and exceptionally at the " morula " stage. No eggs beyond the " morula " stage are ever found in the intestinal tract.

Under favourable conditions after 12 hours the eggs obtained from faeces or laid by females show distinct movements of the embryo within them and by the 17th hour about 50 per cent. of the eggs were found to have hatched. The remainder hatched slowly, but by the 48th hour only a few eggs had not hatched. Hatching of the embryo appears to take place by rapid pushing movements of the head against the shell wall. Eggs obtained from faeces were found to hatch sooner than eggs laid by the female, this being probably due to the fact that while the eggs are passing through the intestines the evolution of the embryo continues.

Larvae.—Different methods were used in the cultivation of the larvae according to the object in view. For diagnostic purposes faeces moistened with water if necessary were placed in a thin layer at the bottom of a suitable covered glass vessel, and placed in an incubator at 26°–35° C. or kept at room temperature. If development occurs the larvae are seen to crawl up the wall of the vessel four days later and can be recognised as white masses branching out in various directions.

When the object was to obtain a large stock of larvae the normal droppings of sheep were found to be the best medium. These were placed in a jar 9 cm. in diameter and 20 cm. high, which was covered

* A short reference to this article has already been made in this *Bulletin* (1916. Dec. Vol. 4. No. 4. p. 166). The above extract of the parts dealing with the bionomics of the worm is inserted at the request of a reader.

with a lid and kept at room temperature. Sufficient air was available inside to permit of the eggs hatching but when fermentation took place all further development ceased. Diarrhoeic faeces and material from the caecum and colon gave very poor results.

For studying the larvae liquid or solid media were used. The best liquid medium was found to be a boiled and filtered decoction of sheep's faeces placed in a layer of about 1 to 3 mm. in thickness at the bottom of a Petri dish; after inoculation with eggs this was enclosed in a covered evaporating dish, and placed in an incubator. Larvae could then be examined microscopically from time to time at room temperature without affecting the rate of development. The best solid medium was found to be a 0·5 per cent. agar concentration, prepared in the same way as the liquid medium.

Eggs placed in pure water were found to hatch but the larvae did not develop and soon died of starvation.

Development of the larvae.—In their evolutive cycle the larvae of *Haemonchus contortus* pass through five stages, separated by structural changes. The first two stages and part of the third one are passed outside the host as free larvae. The second part of the third stage and the fourth and fifth stages are passed in the hosts as parasites. Each stage can be divided into two sub-stages, viz., the first one in which the larvae move rather actively, feed, and develop and a second one in which the larvae are found in a lethargic condition when they neither move nor feed, but undergo structural change. Entering the fifth stage the worm is sexually mature, and is usually called the adult worm.

First Stage.—The naturally hatched larvae vary in size from 340 to 350μ by 15–20μ, and belong to the rhabditiform type. The body is cylindrical, decreasing in thickness from the base of the oesophagus to the tail. After executing a series of active wriggling movements for about an hour after hatching, the larvae commence to feed and steadier movements, which are somewhat slow, are noted. The chyle intestine cells become packed with granules, the larvae stop feeding, become stationary, and enter into the first lethargic condition; this takes place in from 10 to 12 hours, or 24–27 hours after the eggs have been passed by the host. After 8 or 10 hours the larvae revive.

Second Stage.—Ecdysis first of all takes place and the larvae soon increase in size to 500μ, and the lateral lines on the skin become conspicuous. The larvae show active swimming movements, begin to feed again, and the intestinal lumen becomes straightened out and increases in diameter. When sufficient food has been obtained the larvae again move with the object of hiding in the interior of the medium and the second lethargic stage sets in. The beginning of the second lethargus seems to take place after 40 hours after the first ecdysis, or 50–60 hours after the hatching. After about 12 hours the development of the lethargic stage is completed and with the accomplishment of the rather pronounced structural changes the larvae awaken.

Third Stage.—The Mature Larvae. The larvae awaken from the second stage as soon as conditions are favourable, in general three days after hatching. They now execute swimming movements which are fast compared with those noted in the second stage. Another peculiarity is the attempt of the larvae to rise, their object being to reach a suitable locality from which they can find access to the host.

Ecdysis next takes place. In size they varied between 571 by 21μ to 820 by 26·5μ. A certain contraction of the tissues takes place by which the size of the body sensibly decreases while the outer skin becomes thicker and increases in rigidity. Vacuoles in varying numbers and of different sizes are present in the chyle intestine cells and these vacuoles become especially frequent in larvae exposed to unfavourable conditions such as dryness, light, or heat.

Influence of the Environment on the Eggs and Larvae.

Toxic substances produced in the intestine of the host or in faeces as the result of abnormal fermentation interfered with the evolution of the egg and sometimes effected its destruction. Similarly certain chemical compounds such as beta-naphthol, thymol, and picric acid, were tested on eggs and found not only to inhibit development but actually to destroy the vitality of the egg.

A certain amount of air is required for development. The amount needed is very small, but if it falls below a certain minimum inhibition of growth and finally death will occur. Cultures of faeces thus do not develop if made into too thick a paste with water or if carried out in liquid media more than 3 mm. in depth. More air seems to be required for developing eggs and larvae than for resting eggs and mature larvae. Mature larvae kept in water at a depth of 3 cm. were still alive after three months.

Temperature.—The optimum temperature for the development of eggs and larvae was found to be between 20° and 35° C. Accordingly, the author calls normal temperature that lying between 20° and 35° C., high temperature that above 35° C, and low temperature that below 20° C.

A very large number of laboratory experiments were made on the development of the worm at these temperatures, the resistance to extremes of temperature, and the effect of alternating temperatures.

With regard to the effect of various temperatures in the field the following statements are made:—

"In considering first of all high temperatures, the maximum recorded in South Africa under conditions of cloudy moist weather cannot be considered to prevent the development or to kill the larvae of *Haemonchus contortus*. In sunny weather, when the ground is moist, the larvae lying in wet earth or faeces are not necessarily exposed to the same maximum of temperature as that of the atmosphere. Moreover, in these conditions the larvae are able to escape from direct sunlight and shelter in cooler places. The high temperatures experienced on the veld during the summer time help to kill a large number of larvae but, at the same time, many of these larvae can be killed before the maximum temperature is reached. The average summer temperature in South Africa is very favourable for the development of the larvae of *Haemonchus contortus*.

"Concerning the low temperatures experienced in South Africa it may be said that the normal spring and winter temperatures do not prevent the development of eggs or larvae but prolong the period required before the larvae reach maturity. The resistance to adverse conditions of eggs and larvae, and their ability to develop considered in relation to the effects of temperature in the winter season of South Africa depend chiefly on the absence of uninterrupted spells of low temperature; the minimum even if occasionally very low only lasts for a short time during the night, whilst in the daytime the average is the optimum temperature required for the growth of the larvae. In a moderate cold ambient, the larvae also remain in a better state of preservation and for a longer period than in warm weather."

Moisture.—The best consistency of faeces for the hatching of eggs and growth of larvae has been referred to above. It was found that in a liquid medium kept immobile and deeper than ½ cm. a rather small percentage of the eggs hatched after four days, but the larvae made very little progress and within 12–15 days death occurred, presumably owing to lack of air.

The mature larvae appeared to find in water a suitable medium for preservation. A small percentage were found to be living up to the fifth month. The pools of water in the veld thus appear to constitute a suitable environment and to a certain extent a favourable place for infecting the host. The mature larvae appear to prefer pure water to faeces.

With regard to the action of desiccation on mature larvae the following conclusions were arrived at:—

"(1) The larvae of *Haemonchus contortus* do not resist complete desiccation and die before this condition is reached, but under natural conditions they resist (on account of their peculiar structure) the progress of desiccation for a comparatively long time.

"(2) The larvae preferably remain in moist surroundings and by migrating are in a position to seek shelter where the moisture is more constant.

"(3) When dryness sets in the larvae gather in clusters, a peculiarity which can easily be observed under the microscope. These clusters play an important rôle in the preservation of larvae in the field against drought, chiefly when the larvae are surprised on grass by the evaporation of dew or rain."

In a number of laboratory experiments it was found that mature larvae lived for five months in water whilst in dry faeces in the same room after eight days 50 per cent. were dead, and in the desiccator the majority died within four days.

Light.—The eggs and larvae develop under conditions of light such as are observed during the night time or in an incubator. The larvae do not reach maturity if exposed to a diffused bright light during the day. If the diffused light is weak as is noticed in rainy weather they reach maturity equally as well as they do in darkness. In faeces exposed to a strong diffused light the larvae grow as usual; it seems that the larvae pass a certain part of their developmental period on the surface of the pellets when in diffused light. Direct sunlight appears to have a very destructive effect as the larvae hatched out of eggs thus exposed were found invariably killed at the end of the second day; mature larvae were nearly all dead on the fourth day of exposure.

With regard to the action of the sun on infected faeces in the field the following general observations were made:—

"(1) When the weather is warm and the rain is constantly falling for three days, or the ground is kept moist for the same length of time, with a heavy cloudy sky, the majority of the larvae reach maturity

"(2) When the weather is warm and dry, as during the period of drought in summer, or dry and sunny, as in winter, practically all the eggs and young larvae in scattered pellets are killed in two or three days, even if amongst ordinary veld grass.

"(3) Concerning variable weather it is not possible to give any definite rule, owing to the action of the ambient being too complex.

"When infected faeces are passed out on to the veld, a fall of rain, even if prolonged for a day at a time, is not sufficient to allow the majority of the larvae to reach maturity, if sunshine is again constant for a few days. It is only during protracted, rainy weather that a large percentage of eggs

reach maturity. This fact, connected with the facilities the mature larvae have of reaching the host if the surroundings are moist, explains the heavy infection that is noted in a flock after a heavy rainy season.

"Even in summer the percentage of larvae reaching maturity is very low, but the percentage of eggs deposited in the field is very high. (It was calculated that the number of larvae that would hatch from the faeces of an infected sheep when placed in suitable conditions would attain the daily average of three millions). The sun is the chief agent of destruction for eggs and larvae under natural conditions of the veld and the mortality increases with increased dryness of the soil and atmosphere."

Migration of the Mature Larvae.

Very thorough experiments were performed in this connection; the following are the author's conclusions:—

"(1) The mature larvae of *Haemonchus contortus* crawl on to the grass under favourable conditions of moisture, light and temperature.

"(2) The larvae withdraw to the lower part of the grass or into the ground when the surrounding conditions are unfavourable and re-appear on the grass with the return of the favourable conditions.

"(3) The succession of night and day produces a nocturnal ascent and a diurnal descent of larvae on the grass, provided the conditions of moisture are favourable.

"(4) The period during which a colony of larvae, when not interrupted, performs the ascending and descending migration, was found under artificial conditions to last from 20 to 30 days; it varies within rather wide limits according to a difference of the ambient.

"(5) In the veld, at the end of the migratory period, part of the larvae are found dead or alive on the grass; the majority are found sheltered in the tuft of grass, at various depths in the ground.

"(6) It was repeatedly observed that the larvae in the ground were richest in food granulations and in a better condition of preservation than those on the grass. It appears consequently, that the migratory period results in a natural selection of the species by which weak specimens will soon die from exposure, while the stronger are able to find shelter and resist exhaustion.

"(7) The mature larvae stored in the ground are able to pass the winter season without heavy mortality.

"(8) The presence of larvae in the soil cannot be explained by the penetration of the superficial water alone but is due to 'geotropism of the larvae.'"

Infection.

The direct introduction of mature larvae through the mouth of the sheep is always followed by the presence of parasites in the stomach, and the infection was invariably found to be proportionate to the number of larvae administered. Frequently, mature living larvae were found in the droppings the day following the administration. The result was always negative when lambs were affected with eggs or larvae in the first and second stages.

It was found impossible to infect lambs through the skin although the method employed proved to be effective for other species of larvae.

Parasitic Life.

The period of time required for development from the moment when the larva enters the stomach of the host until it reaches the adult stage seems to be liable to variations owing to influences not yet properly understood, but the average can be estimated to be 15 days.

First parasitic stage (or, *parasitic part of the third stage*).—Larvae

introduced into a sheep by means of water reach the abomasum, and here undergo the second ecdysis. The majority of the moulted larvae then take shelter in the mucous membrane of the stomach; only a few are washed into the intestines. They now begin to feed and are found lodged between the epithelial processes where they shelter without actually piercing the mucous membrane.

The third lethargus is reached from the 30th to the 36th hour after the larvae have gained access to the host and lasts about 12 hours. The larvae in this state are more or less curved, completely immobile and hard to waken.

Second parasitic stage (*fourth larval stage*).—The growth of the larvae in this stage appears to be very rapid, for shortly after the third ecdysis many larvae are found to reach up to 1 mm. in length. The larva attaches itself to the mucous membrane by means of its buccal aperture, produces a small haemorrhage, and a clot is formed which surrounds the worm. This is observed three days after drenching with mature larvae. The clots are frequent and measure 1 to 2 mm. in diameter. By the sixth day of this stage the sexes can be easily recognised, and on the succeeding days this distinction becomes more and more apparent. On the ninth day the clots have not increased in size or number but are rather flatter, more contracted and darker in colour. The fourth period of lethargus then succeeds.

Adult worm (*fifth stage*).—The fourth ecdysis takes place between the 9th and 11th days, preceded by a period of lethargus lasting for about 24 hours. The male now measures over 5 mm. by about 90μ in thickness. The mouth cavity is now armed and corresponds in every particular to the mouth of the fully-grown worm. The female measures between 6·5 to 7·9 mm. by from 90 to 130μ in thickness.

On examining the stomach of a sheep 12 days after infection numerous blood clots are present, but they have now become more contracted and of a black colour, adhering to the mucous membrane, whilst petechiae of recent origin are usually found under the clots. These petechiae are caused by the piercing of the mucous membrane by the new mouth apparatus of the larvae, and differ from those previously described inasmuch as they are punctures without any escape of blood. It is rare to find worms outside the clot.

The stomach of a lamb infected 15 days previously still shows in some cases dark red blood clots adhering to the mucous membrane whilst in other cases the clots consist of a residue of yellowish fibrin and ingesta mixed together. In all cases the worms are found in between the clots or distributed on the surface of the mucous membrane itself. Some worms are now found in copulation.

Eighteen days after infection all the clots and fibrin deposits have practically disappeared. In a heavy infestation the mucous membrane is swarming with adult worms. The petechiae are numerous and small, but without any fresh blood clot. Numerous worms are in copulation and numbers of females have laid eggs. The male at this stage measures from 12–13 mm. in length and the female about 17 mm.

Anatomy of the adult worm.—This is described at great length in the original article. The size of the adult worm is given as (1) when collected: male, 15–18 mm., female, 25–29 mm.; (2) after death: male, 18–21 mm., female, 25–31 mm.; (3) 48 hours after collection: male, 17–19 mm., female, 23–27 mm.

VELU. **Un cas interessant de cénurose chez la gazelle.** [An interesting case of Caenurosis in a Gazelle.]—*Rec. Méd. Vét.* 1916. Oct. 15. Vol. 92. No. 19. pp. 555-556.

The gazelle in question was brought for examination to the author with a history of a large swelling of the right shoulder accompanied by lameness. It was found on examination that these apparent defects were simply due to a marked inclination of the neck towards the left. The other symptoms and especially the turning movements led to the condition being diagnosed as one of caenurosis. Three weeks later the symptoms were more pronounced, the animal having become affected with epileptiform fits on two occasions, and a small soft tumour about as large as a pigeon's egg was discovered between the roots of the horns.

In the course of an operation for the excision of this tumour an oedematous swelling of the upper eyelid was noticed causing exorbitation of the eyeball. A caenurous sac 40 cc. in capacity was extirpated, but the gazelle subsequently died from cerebral haemorrhage. Post-mortem examination showed that this large sac had caused partial absorption of the cranium, which had become perforated in many places, the two largest perforations being on the forehead and at the bottom of the orbit, respectively.

PIETTRE. **L'onchocercose bovine dans l'Amérique du Sud.** [Bovine Onchocerciasis in South America.]—*Bull. Soc. Cent. Méd. Vét.* 1916. July 6; *Rec. Méd. Vét.* 1916. July 30. Vol. 92. No. 14. pp. 202-203.

This disease is very common in South America as is shown by the following figures obtained in the case of cattle slaughtered for the manufacture of preserved meat.

Argentine Republic.—Frigorifico La Negra: 70 per cent. of the carcases showed marked lesions of the cervical ligament; 25 per cent. centres on the external surface of the great trochanter.

Uruguay.—Frigorifico Uruguaya: 90 per cent. cervical lesions; 18 per cent. trochanteric lesions.

The distribution of Onchocerca is very different from that usually seen in France. The parasite is found more especially on both surfaces of the cervical ligament between the 1st and 5th dorsal vertebrae, and next at the level of the trochanter between the attached fibrous aponeuroses. The lateral ligaments of the femoro-patellar joint are only exceptionally invaded (16 cases out of 1,000 carcases). The numerous specimens of Onchocerca isolated from the cervical ligament possessed a much greater length than those observed in France; the females reached up to 70 cm., although most often one of their extremities was missing. It is supposed that the loose tissue in which these nematodes develop favours their growth, whilst the density of the ligaments of the stifle joint retards it.

The zoological characters appear to be similar to those of the French form. However, the tail of the male showed six papillae grouped together and two widely-separated small ones, whereas only four could be found in a specimen of *Onchocerca gibsoni*.

The lesions provoked are more marked than in French cattle. One observes congested areas with a peripheral oedema, large verminous nodules surrounded by reacting tissue, pockets hollowed out in the inflamed connective tissue and, finally, very numerous encysted purulent centres.

MYCOTIC DISEASES.

(a) Epizootic Lymphangitis.

Aubry. **La lymphangite épizootique dans la région de Meknès. Organisation de la lutte.** [Epizootic Lymphangitis in the Meknès Area. Method of Eradication].—*Bull. Soc. Cent. Méd. Vét.* 1916. Nov. 9; *Rec. Méd. Vét.* 1916. Nov. 30. Vol. 92. No. 22. pp. 337–346.

This disease was imported into Western Morocco from Algeria by the army of occupation and made its appearance in the Meknès area in 1911, after the conquest of the town. Its rarity in the country districts three years after the French occupation testifies as to its imported origin. On account of the very bad hygienic conditions, hardships, and saddle injuries which beset the horses and mules, the disease rapidly propagated up to 1915 until all units became contaminated in spite of the equine population being scattered in isolated and widely separated stations.

Unfortunately the veterinary infirmary at Meknès into which affected animals were collected was situated amongst other troops, rendering the propagation of the disease still easier; sanction was finally obtained at the beginning of 1915 for the construction of a lazaret between two high walls 4 kilometres away from the camp.

The majority of affected animals admitted was composed of harness or pack animals, that is, animals bearing harness sores. In spite of the prophylactic and therapeutic measures adopted the number of cases exceeded 100 at the commencement of 1915, fell down to 10 at the end of the year, and rose up again to 70 during the winter 1915–1916 during the rainy season. Five animals remained under treatment at the end of the summer of 1916, moreover affected only with sores of limited size.

The following résumé shows the number of animals dealt with at the lazaret :—

Year.	Admitted.	Died.	Destroyed.	Cured.
1914	259	4	50	205
1915	412	2	89	321
1916 (to 10th Aug.)	95	4	11	80
Total	766		160	606

The economic aspect of the disease thus assumes considerable importance both on account of the losses involved by death and destruction and by the cost of upkeep and loss of utility of the animals during the period of infection. The author deals only with the military effectives in this article but the losses among civilian animals have

become serious, especially in the country districts. In eradicating the disease he thus aims at (1) the destruction of actual centres, and (2) guarding against infection of civilian effectives, on which it would be very difficult to take action in a native environment.

Diagnosis of the disease.—The author believes that by means of a simple clinical examination the disease can be easily differentiated from glanders and this is important as in most cases a microscope would not be accessible to the practitioner. Under the low power of the microscope the cryptococcus is easily discernible.

Prophylaxis.—Under the conditions which obtain in the field in Morocco this is very difficult and the part played by the veterinary surgeon of a column or of an outpost consists in eliminating affected animals and transferring them to the rear; during this time the cryptococcus multiplies in the sores and is liable to infect other animals en route. The veterinary surgeon in charge of the intermediate post has greater facilities on account of his fixed position.

Nine times out of ten contagion is brought about through harness wounds and these become infected with the cryptococcus, living in moist earth and dung, by means of contact with harness, earth, flies and personnel in charge. The effect of earth is shown by the number of mules affected especially during the rainy season, as these animals are accustomed to roll on the ground.

The author insists upon the necessity of educating all ranks upon the nature of the disease and accordingly he formulates a list of instructions to be followed by them.

With regard to curative treatment the results enumerated above were obtained by adopting the following measures :—

(1) By the installation of a lazaret.

(2) By the simplest surgical measures, after having tried different more or less difficult and costly treatments. The procedure employed is as follows :—(*a*) Wide opening of abscesses, buds, or corded lymphatics, (*b*) extirpation of affected glands and corded lymphatics if possible, (*c*) washing absolutely forbidden.

The wound is dried (the cotton wool is then burned) and sprinkled with pure powdered potassium permanganate or any other strong powder.

In discussing this paper Bridré notes that the results obtained by Aubry appear satisfactory, but that they might be still more so if internal treatment had been administered in certain cases. As an example he refers to an extremely severe inoperable case which received potassium iodide daily in its drinking water according to Cartier's method and three injections of novarsenobenzol. The treatment lasted four months but the horse was cured and treatment appeared justified on the account of the value of the animal. Cases should not be considered incurable because they are inoperable. The economic aspect should be considered in each case before adopting a line of treatment.

Cartier (J.). **Note sur le traitement de la lymphangite épizootique par l'iodure de potassium.** [Treatment of Epizootic Lymphangitis by means of Potassium Iodide.]—*Rec. Méd. Vét.* 1916. Nov. 15. Vol. 92. No. 21. pp. 614–618.

In the treatment of epizootic lymphangitis, potassium iodide was administered intravenously by Trypaz, but his method appears

inconvenient on account of the necessity of frequently repeated injections and of the introduction of a chemical agent of a great diffusibility into the blood.

The author himself introduces the drug by means of the digestive tract, although this simple method seems to have been abandoned on account of the failures recorded. The potassium iodide should be administered in large doses; from 12 to 20 grammes were administered daily without the appearance of any toxic symptoms. The tolerance of the patient is first tested by means of a relatively large dose, 12 to 14 grammes for example, and the attainment, as rapidly as possible, of the maximum tolerated curative dose is recommended. On account of its diffusibility the administration of the drug at least twice a day is also advised; a 10 per cent. solution, for example, is given in a small mash before each feed. The treatment need not be continuous, and it is advantageous to interpose periods of rest.

The author then details a series of seven observations made in the treatment of more or less advanced cases of epizootic lymphangitis. Cures were obtained in all cases in from about one up to three months.

[The expense of this treatment appears to be a considerable obstacle to its general adoption.—Ed.]

Chapron (H.). **Observations relatives à l'incubation de la lymphangite épizootique.** [Incubation Period of Epizootic Lymphangitis.]—*Bull. Soc. Cent. Méd. Vét.* 1916. Dec. 7; *Rec. Méd. Vét.* 1916. Dec. Vol. 92. No. 24. pp. 402–404.

This short article gives a history of four cases of epizootic lymphangitis occurring in horses which have been issued, each to different units in the French Army, from a depot at a certain date. As these horses must have contracted the disease before they were issued to the units the period of incubation under natural conditions could be easily calculated, and this was 80, 84, 112, and 121 days, respectively, for the four animals. These figures confirm the results of experimental inoculation, by means of which the incubation period had previously been shown to be very long.

Nicolas (E.). **La lymphangite épizootique en France. Son traitement par la méthode Chatelain et sa prophylaxie.** [Epizootic Lymphangitis in France. Treatment by Chatelain's Method and Prophylaxis.]—*Bull. Soc. Cent. Méd. Vét.* 1916. Nov. 9. *Rec. Méd. Vét.* 1916. Nov. 30. Vol. 92. No. 22. pp. 334–337.

This treatment, which consists essentially in the local application of copper sulphate deserves, in the author's opinion, to be made more extensively known on account of the facility with which it can be applied in the field, and on account of the very good results obtained. The procedure is (*a*) open the buds and abscesses by means of a cautery, evacuate the pus, and insert into each puncture a crystal of copper sulphate proportional to the size of the lesion (usually about the size of a pea); (*b*) around the infected area inject 5 cc. of an iodine solution (tincture of iodine, 2; water, 8; potassium iodide, qs.) by means of a hypodermic syringe.

In the author's experience the second part of the treatment is liable to produce considerable swelling and he substitutes for it the following · (*c*) along an excentric line around the infected area and 10 cm. from it a series of punctures, 10 cm. apart, is made by means of a cautery, and a small crystal of copper sulphate is inserted into each puncture.

The affection then remains localised, the buds are reabsorbed. abscesses cicatrise, and corded lymphatics disappear. The affected animals should be carefully observed so that if necessary ulcers which are slow in healing may be cauterised again with copper sulphate and new buds treated as soon as they are formed.

With regard to prophylaxis the author enumerates points dealing with strict isolation, the necessity of using fresh swabs for each ulcer. and the avoidance of dressings. Under field conditions in France all cases of ulcerative lymphangitis should be considered epizootic, and treated as such.

The author refers to the parasite of the disease as *Leucocytozoon piroplasmoides*, a name given to it by Ducloux in 1908.

Bridré, in discussing this communication, refers to the work which has since been done to show that this name is incorrect inasmuch as it is not a Protozoon but a vegetable parasite closely related to the Blastomycetes.

Société de Pathologie Comparée. 1916. Oct. 10 & Nov. 14.—[Epizootic Lymphangitis.]—Reports extracted in *Rev. Gén. Méd. Vét.* 1916. Dec. 15. & 1917. Jan. 15. Vols. 25 & 26. Nos. 300 & 301. pp. 632–636 & 39–40, respectively.

In two sittings of the above society papers were read and discussions took place on epizootic lymphangitis ; the main points are extracted below.

Chenier, in his paper, states that formerly this disease was generally considered as a cutaneous form of glanders, and accounted for each year (in France) from 200 to 300 victims. For the last thirty years it had almost completely disappeared ; only a few rare cases were still observed in the French African possessions. It has been re-introduced into France probably by means of horses from Algeria, and, at the present moment hundreds of cases of it occur. Attempts at intensive therapeutic treatment have been made. Bridré, of the Pasteur Institute, has employed novarsenobenzol, others have had recourse to galyl and potassium iodide. The results are not yet conclusive. Whilst recognising the value of researches made in this direction Chenier, formerly a military veterinary surgeon, to whom we owe the differentiation of glanders from epizootic lymphangitis, as well as the determination of the mode of transmission of the latter disease, believes that it would be unwise completely to abandon cauterisation of abscesses by means of the hot iron, a method of treatment which has been thoroughly tested.

In discussing this paper Petit (A.) states that out of more than 200 cases met with in Morocco he never observed contagion to take place by means of immediate contact. In several cases in which the lesions first affected the eyes, he found the dead bodies of flies in the folds of the conjunctiva, and hence thought that the fly acts as a vector of the disease. He never saw the lesions extend beyond the deeper layers of the dermis.

Surgical treatment with the excision of the corded lymphatics seemed to expose the patients to relapses, either by external re-infection or by omitting to excise the whole of the infected tissue; moreover, cicatrisation is slow and often defective. In order to obtain the largest number of cures in the shortest period of time he thus adopted a treatment consisting in (1) application of a blister, (2) puncturing if necessary, (3) disinfecting the opened abscesses by means of a non-irritating antiseptic.

Curetting favours re-infection and is not recommended. Mercurial blister was even applied over the borders of the eyelids and produced only a temporary inflammation.

The disease appeared to be more severe in the district of Casablanca, with a moist climate, than in the district of Marrakech, a dry country.

Fayet and Bonnel in their paper now disclaim having successfully cultivated the causal organism; the mould resembling Rivolta's cryptococcus which they claimed in a previous communication to have cultivated was in reality a saprophyte from outside sources. Attempts at cultivation from further cases on glycerinised potato have remained negative.

Bridré, in discussing a point raised by Brocq-Rousseu, adduces facts which all workers who have studied the disease hold to incriminate the cryptococcus as the sole cause of infection.

Bilhaut uses chloride of zinc for the suppurative lesions, or other agents such as petrol.

Bridré states that intravenous injections of novarsenobenzol appear remarkably efficacious if administered in sufficient doses, that is, three grammes per horse. The good results claimed to have been obtained by Cartier following the administration of large doses of potassium iodide by ingestion were also corroborated by him.

Chenier believes that while the newer methods of treatment are advisable in some cases one should not be induced to slaughter cases that could be easily cured by the older methods of treatment.

Epizootic lymphangitis with ulcerative lesions of the pituitary mucous membrane.—Cazalbou and Morel (G.) state that glanders even in its clinical form may be mistaken for epizootic lymphangitis, when no reaction follows the mallein test. There exist, however, symptoms characteristic of epizootic lymphangitis but, as it happens, still badly understood.

Whereas it is not very serious to confuse ulcerative lymphangitis with cryptococcic lymphangitis it is far more so to assign Rivolta's lymphangitis to glanders, for in the latter case, one treats a glanderous animal. It would be advisable that special attention should be drawn to those cases labelled epizootic lymphangitis with ulcers of the nasal mucous membrane, in order that the animals might be examined as closely as possible.

Olver states that in the Sudan and in India he observed many cases of lymphangitis with nasal lesions and it was very difficult to differentiate them from glanders. The disease in these countries is very serious and the very numerous flies appear to play a part in its spread, as they were found in the canthus of the eyes of affected animals. In South Africa no nasal lesions were observed in the numerous cases of lymphangitis encountered.

Cases in which pulmonary lesions occurred were mentioned by BRIDRÉ, the first having been published in 1912. In view of the fact that the rôle of flies has been much discussed this observer notes, however, that the disease is especially common in winter during the wet season, which is precisely the season in which flies are least numerous.

In the Sudan, OLVER also noted that it was during the wet season that cases were most frequent, but the long period of incubation must be taken into account. In any case it is certain that the infection can be transmitted by means of dressings, and it is possible that a fly may carry the virus in the same manner from an affected to a sound animal.

JACOULET quotes TEPPAZ who studied epizootic lymphangitis in Senegal, where the natives consider it as a disease of districts infested with flies and appearing when the animals come down into the marshy bush country, and disappearing of its own accord when the animals return to the wind-swept uplands not very favourable to the flies. It is also remarked that these hot moist regions are, as well as being infested with flies, also well suited to a cryptogam flora. However, as evidence against the theory of fly transmission it has been brought forward that the disease occurs more especially during the season when they are very little seen. With these facts in view one must, however, take it into account, firstly, that the period of incubation varies from 60 to 125 days, and of the fact that in Oran, for example, there is hardly any time of the year in which flies are not seen and that it is during these intermediate rainy seasons that they are most tenacious.

JACOULET also refers to a communication of PETIT (A.) who argued that in several cases where the infection first involved the eyes, and the bodies of dead flies were found in the folds of the conjunctiva, the fly should be considered as the principal propagating agent. PETIT was here probably confused for further on he states that he has never seen the disease extend beyond the depth of the dermis whilst in reality the lesions are generally deeper and are seated in the lymphatic system.

As appears to result from the work of CAZALBOU and MOREL it is urgent to avoid all confusion until one has by all means arrived at a diagnosis and eliminated glanders. As regards the invasion of the body cavities it is rare, but still possible, and cases have been published by him (Jacoulet).

In the matter of surgical intervention associated with internal treatment everybody is in agreement with CHENIER.

VELU. **La lymphangite épizootique (Localisation.—Durée d'évolution.).** [Epizootic Lymphangitis. Seats of the Disease and Period of Evolution.]—*Bull. Soc. Cent. Méd. Vét.* 1916. Dec. 7; *Rec. Méd. Vét.* 1916. Dec. Vol. 92. No. 24, pp. 385–388. With 3 tables.

Between May 1913 and April 1915 the author treated 300 animals affected with epizootic lymphangitis at the veterinary infirmary at Casablanca. A careful account was taken of each case and various methods and products were employed in the treatment. In order to appreciate the results it was thought necessary to study the course of the disease according to the seat affected; for example, one might learn that lesions affecting the neck are relatively mild and run their

course in six weeks no matter what treatment is adopted. The seats affected, the extension of the lesions, the length of treatment and average duration of the disease in the case of the various seats, are enumerated in the tables.

In 113 cases (or 37·6 per cent.) the disease developed on the trunk as the result of harness sores, and generally the corded lymphatics emanating from the affected wounds were directed towards the entrance to the chest; exceptionally (2·33 per cent.) they gained access to the precrural gland.

Lesions on the limbs represented only 19·33 per cent. of the cases treated. The hind limb was more often affected (35 cases) than the fore limb (23 cases). Invasion of the upper parts of the limbs was more frequent than extension along the whole limb (23 cases as against 12 for the hind, 18 as against 5 for the fore limbs).

The head was fairly often affected (16 per cent.), then came localisations on the shoulder (11·6 per cent.) and on the breast (7 per cent.). Neck lesions are rare (2·66 per cent.), as well as those of the lumbar region (2·66 per cent.), and genital organs (2·66 per cent.).

Lesions of the mucous membranes (sheath, vulva, nasal, conjunctival) remained the most refractory to treatment. All the animals recovered, but the average duration of treatment reached or exceeded four months.

Lesions of the withers are equally serious, inasmuch as they often involve the bony tissue and become complicated with chronic suppurations which evolve in about four months or necessitate destruction.

Localisations on the limbs were curable rather more quickly—in from three to four months on an average. Lesions affecting the hind limb are in fact more difficult to cure than those of the fore limb. The disease affecting the lumbar region, breast, and shoulder is less severe than that of the limbs, back, or sides, since it runs its course in less than three months.

Finally, localisations of the head (cutaneous) and neck are comparatively benign, since a cure can be brought about as a rule in six weeks.

(b) Sporotrichosis.

Davis (D. J.). **The Permeability of the Gastro-Intestinal Wall to Infection with *Sporothrix schenckii*.—*Jl. Infect. Dis.*** 1916. Nov. Vol. 19. No. 5. pp. 688-693.

In this article an account is first given of the literature dealing with the permeability of the mucous membrane of the gastro-intestinal tract to organisms of various kinds. The permeability of the mucous membrane to sporothrix organisms was investigated by feeding rats with cultures of typical *Sporothrix schenckii* isolated from the human subject, rats being highly susceptible to experimental inoculation. The cultures were ground up in a mortar and mixed with milk.

Tests were made to determine the length of time the Sporothrix remained alive in the stomach of the rat. At the end of two hours after ingestion the organisms could be seen and readily recovered by culture. At the end of three hours they could usually be recovered. At the end of four hours, in the case of four rats, the author could not detect the organisms in smear or in culture.

A number of animals died within a short period of time following the feeding; examination of the heart blood and other body fluids in these cases did not reveal any Sporothrix organisms. The history of 13 animals fed regularly over a period of several weeks or months is tabulated. It appears that only two of these animals showed on post-mortem examination distinct lesions of sporothricosis, as evidenced by nodules in the omentum, mesentery, and lymphatic glands. The organisms fed in these experiments had been previously shown to be highly virulent for rats by subcutaneous or intra-peritoneal inoculation.

The author quotes GOUGEROT, who fed rats and young guinea-pigs with cultures of *Sporothrix beurmanni*. Two rats were fed with large amounts of such cultures for six months; both animals became infected and after ten months one died and the other was killed; extensive sporothricotic lesions were found in both.

The author's summary is as follows:—

"White rats fed at intervals of a few days with large quantities of cultures of *Sporothrix schenckii* may become infected.

"The infection tends to localise in the mesentery, peritoneum, and spleen.

"The organisms appear to penetrate the normal mucosa of the intestinal tract. No lesions active or healed were visible in the mucosa or in the wall of the stomach or intestines."

MEYER (K. F.). **Notes on the Occurrence of Equine Sporotrichosis in Montana and the "Blastomycotic" Form of** *Sporotrichum schencki-beurmanni*.—*Proc. Soc. Exper. Biol. & Med.* 1916. Oct. 18. Vol. 14. No. 1. pp. 23–24.

"In 1915 I expressed the belief, based on very inadequate material, that animal sporotrichosis is found also in Montana. Quite recently, through the courtesy of Doctor Du Frene, of Glendive, fresh pus collected from a case of equine sporotrichosis was forwarded to me for diagnosis. Without the least difficulty a typical *Sporothrix schenki-beurmanni* was isolated on Sabouraud medium, and conclusive bacteriologic evidence was thereby obtained that sporotrichosis exists endemically in Montana.

"As is customary in our studies on fungi, plain one per cent. glucose agar was inoculated with the pus. The growth on this medium remained perfectly white and thin, becoming thick, moist, very stringy and inelastic in contrast to the typical well-pigmented folded film observed on Sabouraud's agar. The culture did not penetrate into the superficial layers of the agar, and was easily emulsified. It grew well under anaerobic conditions, and produced a rapid septicaemia in rats and rabbits. On one per cent. glucose agar and plain potato, this pleomorphism has remained so far (three weeks and four transplants) constant, but on Sabouraud medium the typical growth invariably appeared in a short time.

"Microscopically, such a culture consists of oblong, oval or round, short, monilia-like mycelia with a well-marked double membrane and refractile granules. Some round forms show reproduction by budding and aggregations in pairs or short chains. Long mycelia with typical clusters of spores were always absent. Macroscopically and microscopically these cultures appeared in every respect like yeast or saccharomyces.

"The 'blastomycotic' pleomorphism has been observed by Gougerot for the *Sporotrichum beurmanni*, but has never been described for the American strains. When transplanted on very moist and soft agar, I repeatedly noticed, for at least three to four days, the yeast-like character of some human strains isolated from cases in North America, but such cultures always returned to the typical growth within ten days.

"The tendency of a recently isolated strain of sporothrix to revert to its parasitic pleomorphism under unfavourable conditions (moisture, absence of oxygen, and carbohydrates) appears to be characteristic of the European

as well as of the American types, and clearly proves their close botanical relationship with the 'blastomyces.'

"Serologic tests have previously shown that complement fixation is regularly obtained with sera of infected or immunised animals when various yeasts are used as antigens."

BACTERIAL DISEASES.

DOLD (Hermann). **Vier weitere Fälle von natürlich erworbener bazillärer Dysenterie beim Hunde, nebst Beobachtungen über Bazillenträgertum.** [Four Further Cases of Naturally Occurring Bacillary Dysentery in the Dog, with Observations on the Carrier Problem.]—*Deutsche Med. Woch.* 1916. July 6. Vol. 42. No. 27. pp. 811–813.

In 1915 the author and FISCHER (W.) published the first confirmed case of bacillary dysentery in the dog. This occurred in a sporting dog kept in the neighbourhood of Shanghai and worked over ground where multiple opportunities for infection from human faeces arose owing to the lack of hygienic conditions among the natives. According to the sportsmen of the district dogs often passed mucous, blood-stained faeces in these parts.

Out of seven dogs, brought to the author for examination affected with diarrhoea, four were found to be infected with dysentery bacilli. A record of each of these cases is given, containing a history of the course of the disease, including the condition of the faeces; the results shown were obtained by microscopic examination of the faeces, cultivation on Endo plates, from the characters of growth of suspected colonies in the various test media, and from the agglutination titers of the strains obtained from each case against each of three different known agglutinating dysentery sera (Flexner, Shiga-Kruse, and Y, respectively). No opportunities for post-mortem examination occurred as the animals were taken back by their owners, and three out of the four affected cases recovered.

It was found that the four dogs affected with clinical symptoms of dysentery on bacteriological examination gave the following results:—

Case 1. Dysentery bacilli (Flexner type) and rare, not regularly found, amoebae and flagellates.

Case 2. Dysentery bacilli (Y type) and amoebae.

Case 3. Dysentery bacilli (Flexner type) and eggs of *Schistosomum japonicum.*

Case 4. Dysentery bacilli (Shiga-Kruse type).

The various types of dysentery bacilli were further tested as to their respective virulence by rabbit inoculation. In all four cases the serum of the dogs gave a distinct agglutination reaction against the respective types isolated from the faeces or from the blood (1 : 300, 1 : 100, 1 : 300, and 1 : 120, respectively).

"Case 4 was a pure bacillary dysentery as well as Case 3, for the *Schistosomum japonicum* could hardly have contributed towards the clinical symptoms. In Case 1 the amoebae, the pathogenicity of which was not determined, apparently were only of subsidiary importance inasmuch as they were very few in number and not always present in the faeces. In Case 2, in which the amoebae were numerous and constant, a mixed infection

was possible ; while the importance of the amoebae was not known the importance of the bacilli was apparent on account of the specific immune reaction of the serum of the infected animal."

The author next infected a healthy animal, the faeces of which were free from dysentery bacilli, with a culture of dysentery bacilli (Strain Y) by feeding. No clinical symptoms followed and the faeces of the dog remained normal in consistence, but dysentery bacilli could be isolated from them for a period extending over three months.

In order to determine the persistence of dysentery bacilli in the mouth and especially on the tongue a dog which had swallowed the bacilli was caused to lick Endo plates daily. It was found that dysentery bacilli could be isolated from the tongue for a period extending up to 13 days after infection.

VAN SACEGHEM (R.). **Etude sur des cas de dermite ulcéreuse des Equidés observés au Congo Belge.** [Ulcerative Dermatitis of Equines in the Belgian Congo.]—*Bull. Soc. Path. Exot.* 1916. Nov. Vol. 9. No. 9. pp. 675–679.

Several cases of specific ulcerative dermatitis were observed by the author especially amongst asses. Horses were equally susceptible but the lesions never assumed the pernicious character they did in the case of the donkey. The disease affected African as well as European breeds of asses.

A detailed account of three cases is given in which the lesions affected the breast, the knee, and the right side of the chest respectively. The last described ass also gave birth to a young animal which soon succumbed to the disease.

The lesions consisted of an ulceration of the skin, a necrosis of the underlying tissues with the formation of numerous fistulae, together with the presence around the ulcer of small very firm tumours which on section disclosed a characteristic oily pus. The disease remained quite refractory to treatment.

Clinically the disease resembled epizootic lymphangitis, but no cryptococci could be discovered in the pus. Glanders was eliminated by the mallein test. The bacillus of Preisz-Nocard could not be discovered and inoculation of virulent pus into sheep gave negative results. Smears from the oily pus of the lesions always showed the presence of small cocci, 0·5 microns in diameter, in the form of diplococci, or in masses, or in short chains. The organism grew well on serum in the form of short-chained streptococci.

Inoculation into guinea-pigs produced a firm swelling which later suppurated. A culture killed by heat injected into an affected ass produced a thermic reaction together with a marked local reaction. The author proposes the name *Dermatococcus congolensis* for this micrococcus.

In discussing this paper, BRIDRÉ mentions that in several cases of ulcerative lymphangitis in France he has been able to find a small Gram-negative micrococcus in a pure state, free or included in the leucocytes, in pus taken from unopened abscesses. He also notes that in the disease attributed to the Preisz-Nocard bacillus this bacillus was not found by NOCARD in all the horses he examined. In BRIDRÉ's cases the lesions always affected the hind limb, contrary to the dermatitis observed in the Congo asses by Van Saceghem.

DISEASES DUE TO ULTRA-VISIBLE VIRUSES.

(a) Foot and Mouth Disease.

Kallert (E.). **Untersuchungen über Maul- und Klauenseuche. IV. Mitteilung. Die bei Maul-und Klauenseuche im Pansen des Rindes auftretenden Veränderungen.** [Lesions in the Rumen of Cattle affected with Foot-and-Mouth Disease.] — *Arbeit. a. d. Kais. Gesundh.* 1915. Dec. Vol. 50. No. 2. pp. 159–163. With 2 plates (1 coloured) comprising 7 figs.

The importance of lesions produced in the rumen of cattle in foot-and-mouth disease is masked by the more obvious external lesions; on account of the possibility of secondary infection by absorption of bacteria and toxins from the decomposing contents of the rumen these changes, however, have a considerable influence on the course of the disease.

Naked-eye examination of the lesions reveals the presence of aphthae or blisters lying side by side in various stages of development. The smallest consist of brownish-red or dark-red slightly raised specks about the size of pins' heads; these increase in size until one sees irregular, raised, rounded or oval areas about ½ cm. in diameter. Transverse section shows that the raising of these patches is due to a marked exudation of blood between the layers of the epithelium.

Further changes consist in the shedding of the upper layer of the blister and this is probably soon effected owing to the movements of the stomach contents. The blood clot in the blister cavity is then removed showing the base of the blister, which is of a light-red or grey colour.

The most extensive formation of blisters takes place on the membrane covering the pillars of the rumen while none may be found in the region of the long papillae. The development of the aphthae must take place rapidly as all stages are found in animals slaughtered while suffering from the disease. It is presumed that healing takes place in the same manner as in the case of the skin lesions.

Microscopic alterations.—The author gives a description of the histology of the normal rumen epithelium. The commencing changes appear to take place by the rupture of the capillaries embedded in the papillae of the lamina propria or connective tissue layer. The extravasated blood appears to traverse through the deepest epithelial layer (stratum cylindricum) and infiltrate the next layer (stratum spinosum), which thus becomes destroyed and replaced with blood mixed with strands of epithelium.

This early haemorrhagic infiltration is therefore comparable to what one commonly finds in inflammatory diseases involving any part of the mucous membrane of the digestive tract.

The upper horny layer (stratum corneum) together with the underlying cellular detritus is soon lost through the mechanical action of the rumen contents. The base of the small ulcer is thus formed almost entirely from the connective tissue papillae, still covered with remnants of the destroyed epithelium, the layer of cylindrical epithelial cells (stratum cylindricum) showing a marked persistency.

Instead of being sharply circumscribed as in the case of the skin aphthae, the rumen lesions show another peculiarity in that while

they are still intact the contained cellular detritus tends to infiltrate for some distance around and in between the layers of intact epithelium.

The author concludes that in foot-and-mouth disease the changes occurring in the rumen of cattle comprise typical blisters or aphthae which differ macroscopically and microscopically from the aphthae appearing on other parts of the body in a few particulars, especially in an influx of blood into the aphthae and an early loss of the covering epithelium.

(b) Fowl Pox.

Gallagher (B.). **Epithelioma contagiosum of Quail.**—*Jl. Amer. Vet. Med. Assoc.* 1916. Dec. Vol. 3. No. 3. pp. 366–369.

Epithelioma contagiosum (avium) or bird pox is stated to have been shown by recent investigators to be identical with avian diphtheria, the causal organism being capable of producing either the hyperplastic epithelial nodules characteristic of the former, or the croupous and diphtheritic pseudo-membranes on the mucous membranes of the head associated with the latter disease.

The outbreak observed by the author occurred in live quail which are imported in large numbers from Mexico into the United States for the stocking of game preserves. Four hundred birds were under observation and the mortality during a period of five weeks amounted to 85 per cent. The symptoms and lesions exhibited by affected birds consisted, in some cases, in the eyes only becoming infected ; in others, the diphtheritic exudate was found in the nasal passages and in the mouth. Most of the birds showed typical bird pox lesions on the skin especially of the wings and around the head, which had become more or less ulcerated during transit in crates. In many cases all lesions mentioned were present on one individual.

Transmission experiments.—In one series of experiments emulsions made from the quail pox nodules and also quail diphtheritic material from the mouth were spread on the lightly scarified surfaces of the combs and wattles of young fowls. In each case characteristic pox nodules developed at the points of inoculation after a period of 6–8 days. The lesions were, however, not so marked as those produced by artificial inoculation of chicken pox from fowl to fowl.

After rubbing the emulsions on to the oral mucous membranes, lightly scarified, of half grown fowls typical croupous patches appeared in seven days.

Two fowls inoculated intravenously with emulsion remained unaffected.

Experiments to determine whether the disease was produced by a filterable virus apparently all gave negative results.

(c) Rinderpest.

Boynton (W. H.). **Rinderpest in Swine, with Experiments upon the Transmission from Cattle and Carabaos to Swine and Vice Versa.** —*Philippine Agric. Rev.* 1916. Fourth Quarter. Vol. 9. No. 4. pp. 288–336. With 2 plates and 10 charts. 1916. Manila Bureau of Printing.

While working on rinderpest in the field in the Philippine Islands it had been noticed for many years that simultaneously with the appear-

ance of the disease in cattle and carabao in certain localities pigs also became affected. Evidence that pigs played a rôle in the spread of rinderpest was especially brought forth in the course of an investigation into an outbreak of the disease causing serious losses among cattle in the island of Romblon, where previously the disease had never existed, and no cattle had been imported there for a long time; it was found, however, that pigs had been imported from another island where rinderpest was prevalent and that first of all the pigs died in considerable numbers before the cattle and carabao began to die in a village.

Hitherto the disease had been overlooked in pigs as, owing to the prevalence of swine fever and other infestations, an unthrifty condition among pigs was very prevalent throughout the islands.

Pigs which had been hyperimmunised against swine fever in the laboratory in 1914, when exposed to cattle sick with rinderpest each developed symptoms similar to those caused by the disease in cattle.

Reference is made to the scanty and contradictory literature on the subject. CARRÉ and FREIMBAULT (1898), in Indo-China, demonstrated the possibility of transmitting rinderpest from pig to pig by contact and by blood inoculation, and also from bull to pig and from pig to bull by blood inoculation. LEBLANC (1886) found rinderpest among peccaries, and PENNING claimed to have transmitted the disease to wild boar. PLUNING noticed rinderpest in swine in Sumatra. THEILER claimed to have transmitted rinderpest to swine by inoculation of blood from cattle affected with rinderpest. JOBLING (1903), in the course of an experiment upon rinderpest in the Philippine Islands, inoculated a pig with 5 cc. of virulent rinderpest blood from a bull; the pig developed typical symptoms of rinderpest; a pig inoculated with blood from this pig did not develop symptoms of the disease, whereas a bull inoculated with the same blood developed typical symptoms of rinderpest, but ran a mild course of the disease, and on slaughter lesions of rinderpest were noticed.

The author then details a long series of experiments upon the transmissibility of rinderpest.

(1) The first series, in which pigs were exposed to cattle sick with rinderpest, consists of ten separate experiments. The pigs were exposed in two small stalls, the sick cattle being tied in these stalls while the pigs were unrestrained during the exposures. All the pigs used in the experiment had been kept in quarantine for a certain length of time, varying from 20 up to 76 days, their temperatures being taken twice a day and their daily physical condition noted. A history of the affected bulls is included in each experiment as well as the known history of each pig prior to the experiment.

It was found that all the pigs after exposure contracted a disease and developed symptoms characteristic of rinderpest in cattle and carabao. Three of the animals developed their initial rise of temperature on the 3rd day, four on the 4th day, one on the 7th day, one on the 8th day, and one on the 9th day of exposure. The incubative period of the disease in pigs thus corresponded very closely to that in cattle and carabao, in which it varies between 3 and 10 days.

Of the pigs used two died, four recovered but remained unthrifty and were killed, although under normal conditions these animals would undoubtedly have been allowed to live, and of these four one contracted swine fever. Three presented very mild symptoms, showing

only a temperature reaction and recovering rapidly; these animals under field conditions would hardly have been suspected of being sick. One was bled to death for virulent blood, thus making the natural result uncertain.

The above ten pigs were exposed altogether to 19 cattle affected with rinderpest. Of these 19 cattle 14 died of rinderpest, three recovered, and two were bled to death for virulent blood, thus making uncertain the natural outcome of the disease.

The mortality among the cattle in these experiments was accordingly 73·7 per cent., as against 20 per cent. in pigs.

(2) In the second series, consisting of three experiments, pigs which had been kept in quarantine for a certain length of time were exposed to pigs affected with the disease contracted from cattle affected with rinderpest. Two of the animals developed a rise of temperature on the 4th day after initial exposure and one on the 5th day; two died and one recovered but was finally destroyed on account of its unthriftiness. The mortality in pigs exposed to rinderpest-affected pigs thus appears higher than that of pigs exposed to rinderpest-affected cattle.

(3) In the next experiment rinderpest is shown to have been transmitted from pig to pig by means of a caretaker. The author had previously shown that in the case of cattle and carabao the virus of rinderpest was in such a condition that it was unable to cause the disease after a corral had been freed from sick animals for 24 hours. The pig used in this experiment was put in a corral in which there had been placed ten days previously two pigs that had died of rinderpest and had also shown lesions of swine fever on post-mortem examination. The pig thus exposed did not contract rinderpest, but developed a rise in temperature and showed mild symptoms which were diagnosed as those of swine fever. Three weeks later two pigs showing acute symptoms of rinderpest which terminated in death were placed in a corral 50 yards away from this pig and looked after by the same caretaker. Nine days later the pig showed a rise in temperature and died four days afterwards showing typical lesions of rinderpest on post-mortem examination.

(4) In the next series of experiments two pigs were inoculated with virulent blood from two pigs affected with rinderpest. The first pig was inoculated with 10 cc. of virulent blood and showed a rise of temperature on the 3rd day and died on the 4th day without showing any marked lesions. The second pig was inoculated with 2 cc. of virulent blood from another rinderpest affected pig and showed an initial rise of temperature on the 3rd day and on the following days showed loss of appetite and diarrhoea, and then gradually recovered, but remained unthrifty; the disease is stated to have run a typical course of rinderpest.

(5) In the following series of experiments pigs were inoculated with virulent blood from cattle affected with rinderpest. Four pigs were thus inoculated with blood from four bulls respectively, the history of which is outlined in each experiment. Both the pigs used in the first two experiments after an incubation period of three days ran a severe course of the disease and died presenting typical lesions of rinderpest on post-mortem examination. The other two pigs did not contract rinderpest and it is concluded that as they were known to have shown

a high temperature and developed diarrhoea prior to being used in these experiments they had been rendered immune by means of a previous mild attack of rinderpest.

(6) In another experiment a quarantined pig was inoculated with a mixture of virulent blood from a bull and a pig, both affected with rinderpest. The inoculated pig developed a rise of temperature three days later and died on the 20th day, presenting well-marked lesions of rinderpest on post-mortem examination.

(7) A known non-infected pig was drenched with 50 cc. of virulent blood from a carabao. Four days later it showed a rise of temperature and on the 6th day it was bled to death for virulent blood to be used in immunisation work.

(8) A series of six experiments were next performed in order to demonstrate the transmission of rinderpest to cattle by exposure to affected pigs. The results of these experiments are not altogether conclusive.

In the first experiment a quarantined bull was placed in the same corral as two rinderpest-affected pigs for 15 and 12 days respectively; the bull remained unaffected. Inoculated later with virulent blood from a bull it died from rinderpest as the result of the inoculation.

In the second experiment a bull placed with an affected pig also failed to contract the disease but subsequently remained unaffected as the result of inoculation with virulent bovine blood.

In the third experiment a bull was placed in the same corral as two rinderpest-affected pigs for 16 and 11 days respectively; the bull remained unaffected. The bull was later proved to have been susceptible during the exposure as it contracted rinderpest when inoculated with virulent bovine blood.

In the fourth experiment a bull, previously kept under observation for 332 days, was exposed to infection from two pigs directly and one pig indirectly by means of a caretaker. These pigs all showed acute symptoms and died later, showing typical lesions of rinderpest. The exposure in each case lasted one, nine, and five days, respectively, or fourteen days from beginning to end. Two days after the end of the exposure the bull commenced to manifest symptoms which became subacute in character, until the animal died 23 days later, showing typical lesions of rinderpest on post-mortem examination.

In the fifth experiment a bull was exposed for four days to a pig showing subacute symptoms of rinderpest from which it later recovered; the bull remained healthy but was proved afterwards to have been susceptible by inoculation with virulent bovine blood.

In the sixth experiment a cow placed for four days in the same stall as an infected pig showed a rise of temperature six days after the first exposure, later developed typical symptoms of rinderpest, and was bled to death on the 10th day for virulent blood.

(9) In a series of four experiments cattle were inoculated with blood from pigs affected with rinderpest. All except one readily contracted the disease, the failure being noted in the case of a bull which was inoculated with only 0·5 cc. of blood. It is admitted that a much smaller quantity has been demonstrated to transmit the disease when virulent blood is taken from a sick bull.

(10) In another experiment it was shown that the potency of the virulent blood is not materially affected by mixing pig and cattle blood.

(11) Two experiments were performed in which cattle were drenched with urine from affected pigs. In one experiment a bull drenched with freshly collected urine contracted the disease, while the result was negative in the case of the other animal drenched with urine stored overnight.

(12) A carabao exposed to a couple of pigs affected with rinderpest developed the disease and later died showing lesions of rinderpest on post-mortem examination.

(13) In another experiment a carabao contracted rinderpest when inoculated with blood from an infected pig.

(14) Two further experiments showed that pigs will contract rinderpest when inoculated with virulent blood from a carabao. One of the pigs died from the disease while the other showed symptoms but gradually recovered.

(15) Four pigs were placed in separate stalls in a shed where cattle affected with rinderpest were kept and both pigs and cattle were looked after by the same man. Three of the pigs died of rinderpest while the other showed symptoms but recovered.

(16) In another experiment ten pigs which had recovered from rinderpest were again exposed to the disease by contact with affected animals. It was discovered that apparently a permanent immunity was conferred on them against rinderpest after recovery from one attack—at least, for practically two years.

(17) Pigs which had recovered from rinderpest were shown to be capable of becoming infected later with swine fever in the course of an experiment in which four pigs which had recovered from rinderpest were separately exposed to swine fever by contact with groups of pigs suffering from this latter disease. Two of the pigs died and two showed symptoms of swine fever, while all on post-mortem examination presented lesions of the disease.

(18) In the last series of experiments pigs hyperimmunised towards swine fever were shown to be capable later of contracting rinderpest. Seven pigs which had been inoculated with very large doses of virulent swine fever blood were separately exposed by contact to bulls suffering from rinderpest in varying degrees of severity. All the pigs showed quite marked temperature reactions and three of them more or less well developed symptoms, but none died. These results indicate that no immunity was conveyed against rinderpest by the swine fever virus "although the animals ran a milder course of the disease than has been usually witnessed in the laboratory."

The author sums up the results of all these experiments as follows :—

"It will be noted that cattle, carabaos and pigs vary but slightly in susceptibility to rinderpest, and that the disease can be transmitted practically as readily from one type of animal to the other, as among their individual kind."

[It is unfortunate that the existence of swine fever, especially in the case of the outbreaks among quarantined animals mentioned by the author, renders some of the experiments rather difficult to follow.—Ed.]

(d) VARIOLAE.

CAMUS (L.). **La Vaccine généralisée expérimentale.** [Experimental Generalised Vaccinia.]—*Bull. Acad. Méd.* 1916. Oct. 31 & Nov. 28. (Report extracted in *Rev. Gén. Méd. Vét.* 1916. Dec. 15 and 1917. Jan. 15. Vols. 25 & 26. Nos. 300 & 301. pp. 632 & 38–39 respectively.)

"Generalised vaccinia is an affection characterised by an eruption of vaccinal pustules in places that have not been in contact externally with the vaccinia. The eruptions are provoked by a localisation of the virus carried by the circulation. This affection is exceptional in the case of man; its existence has been doubted by very competent medical men. Chauveau, in 1856, experimentally reproduced this exanthema in the horse by intravenous injection of vaccinia; since then all similar attempts on other species of animals have remained without result.

"Camus shows that the cause of these failures lies in the use of insufficient quantities of virus. Invariably one obtains generalised vaccinia when a sufficient quantity of virus is passed into the blood stream. In the case of a dozen rabbits he succeeded a dozen times in reproducing generalised vaccinia. An animal is shown bearing numerous pustules which appeared spontaneously after an injection of vaccinia. The exanthema first appears on the third day, and is confined to the natural orifices and the parts surrounding them. The buccal cavity, tongue, lips, nostrils, eyelids, the perineal region, and parts of the skin where naevi are found, are predilection seats.

"A calf and a monkey are exhibited, both affected with a marked spontaneous eruption of vaccinal pustules provoked by an intravenous injection of homogenous vaccine. . . .

"The aspect of this exanthema in the case of the monkey is incontestably as typical as that of the calf but one cannot fail to remark that the mucous membranes have been infected with as great an intensity as in the case of the rabbit. The eruption on the calf on the contrary resembles much more that of the dog, in which the mucous membranes remained intact and in which the numerous pustules are located almost exclusively on the skin."

CAMUS (L.). **A propos de la Vaccine Généralisée chez le chien.** [Generalised Vaccinia in the Dog.]—*C. R. Soc. Biol.* 1916. Nov. 18. Vol. 79. No. 18. pp. 1008–1009.

The author presents a dog which he claims to be affected with generalised vaccinia following the injection of a large quantity (3 cc. per kilo). of vaccine virus intravenously. The first eruptions appeared on the seventh day on the skin of the head and on the limbs, and on the following day a large number of minute pappules were found disseminated on the whole surface of the body.

The disease produced was peculiar in that the visible mucous membranes were nowhere involved. The disease caused only a very mild general disturbance.

CAMUS (L.). **La Vaccine Généralisée chez le cobaye.** [Generalised Vaccinia in the Guinea-Pig.]—*C. R. Soc. Biol.* 1916. Dec. 16. Vol. 79. No. 20. pp. 1108–1109.

A small guinea-pig which received 1 cc. of vaccine lymph intravenously showed a small pustule on the fourth day on the vulva; on the fifth day numerous eruptions were found on the buccal region, especially on the lips: on the sixth day the eruptions had become distinct and the edges of the nostril showed several while the tongue was covered with them.

In thus becoming localised on the mucous membranes the eruptions resembled those of the rabbit and of the monkey; on the other hand in the cases of the dog and the calf the mucous membranes are hardly ever affected.

GAUDUCHEAU (A.). **L'Immunisation variolique du singe.** [Variolar Immunisation of the Monkey.]—*Bull. Soc. Path. Exot.* 1916. Nov. 8. Vol. 9. No. 9. pp. 669–672.

The immunisation of the monkey by means of variola against vaccinia has recently been disputed by WURTZ and HUON, as well as by ROGER and WEIL. In this article the author records an experiment, carried out by him at the Vaccine Institute in Tonkin (French Indo-China), from which the following results were obtained.

The variola virus was obtained from an Annamite, and two monkeys (*Macacus rhesus*) were inoculated by applying the virus to extensive scarifications along the back; one of these died following the inoculation while the other presented a very marked exanthema. The virus was collected from this latter animal and inoculated into two other monkeys and two buffaloes. Pustules developed on the monkeys, but none on the buffaloes.

About a fortnight after inoculation with the variola the above three surviving monkeys were inoculated on the buttocks and on outside of the thighs with Jennerian vaccine (etherised vaccine on right side and ordinary vaccine on the left). Three control monkeys were inoculated in the same way. In the case of the variolised animals no eruption developed whereas in the case of the controls typical pustules were observed, developing more tardily where the etherised vaccine was employed.

The author believes that it is quite possible to perform such experiments without accidental contamination in the first place with cow pox. He mentions that a strain of variola was kept up for three years in his laboratory by means of 43 successive passages in the monkey; during this time the virus was tested on more than 100 bovines and rabbits, always with negative results.

In conclusion, the author states that in the case of the monkey as in the case of other animals susceptible to variola and vaccinia a real immunity is conferred by variola against vaccinia.

MISCELLANEOUS.

(a) Pleuro-Pneumonia of Goats.

Mori (N.). **Sulla profilassi e sulla cura della Pleuropolmonite essudativa delle capre.** [Preventive and Curative Treatment of Exudative Pleuro-pneumonia in Goats.]—*Moderno Zooiatro.* Parte. Sci. 1916. Dec 31. Vol. 5. No. 12. pp. 285–289.

The work of this author in connection with exudative pleuro-pneumonia of goats has already been referred to in this *Bulletin*, [Vol. 4, No. 4, pp. 179–181]. In the articles then extracted he claimed to have discovered the causal organism which he stated was an Aspergillus, difficult to isolate from the lesions, but growing quite readily afterwards on sub-culture. He also described the presence of very minute corpuscles found both inside the leucocytes and free-lying in the pleuritic exudate. These he identifies as the conidiospores of the Aspergillus.

The disease has recently caused very serious losses in Central and Southern Italy, where the mortality sometimes exceeded 90 per cent. It seems probable that the disease was introduced from Serbia by means of fugitives during the war; it has been found that the disease actually existed in Serbia and Albania before the arrival of the Serbian goatherds.

The author refers to the impossibility of transmitting the disease experimentally by contact and of reproducing symptoms similar to those of the natural disease by inoculation.

Although experimental infection seems difficult or impossible to realise the author recommends segregation or slaughter of infected herds, inasmuch as in two outbreaks investigated infection was strongly believed to have been introduced by means of infected he-goats brought in for breeding purposes. Infection by indirect contact, due to the inhalation of the conidiospores of the Aspergillus, would likewise be eliminated. Disinfection of infected sheds, etc., is prescribed.

Good results in the prevention and cure of the disease are claimed to have been obtained by the inoculation of goats with a specific product consisting of the abundant serous exudate found in the pleural cavities of affected animals; this is freed of the tissue elements contained in it and treated with toluol or ether.

(b) Extermination of Locusts.

d'Hérelle (F.). **Campagne contre les *Schistocerca Peregrina* en Tunisie par la méthode biologique (Avril–Juillet 1915).** [Campaign of Eradication of *Schistocerca peregrina* in Tunis by Means of the Biological Method.]—*Arch. Inst. Pasteur. Tunis.* 1916. Apr. 1. Vol. 9. No. 3. pp. 135–143.

Conclusion.—"As applied to Tunis the organisation of destructive measures against migratory acridians by means of the biological method would not incur heavy expenditure and would have as immediate results the destruction of the greater part of the swarms of locusts situated in desert and uncultivated areas where mechanical methods of destruction cannot be applied on account of distance, lack of labour, and difficulties of accessibility.

"By reducing the number of locusts in the cultivated areas—and that in a more radical manner the more numerous the infestations, which

resolves itself into a question of personnel—the biological method applied in an intensive manner would facilitate to a very great extent the production of crops and prevent irruptions with certainty.

"On account of the considerable diminution in the number of locusts the expenditure necessitated for mechanical means of destruction would be greatly reduced; this diminution in the number of insects, by relieving the mechanical means of operation, would entail, in consequence, a reduction in the number of natives employed for these means, a very tangible advantage in Tunis for multiple reasons into which it would take too long to enter here."

BÉGUET. **Quatrième campagne contre les Acridiens (*Schistocerca peregrina* Ol.) en Algérie au moyen du *Coccobacillus acridiorum* d'Hérelle.** [Fourth Campaign against Locusts in Algeria by Means of d'Hérelle's Coccobacillus.]—*Bull. Soc. Path. Exot.* 1916. Nov. Vol. 9. No. 9. pp. 679–682.

Hitherto experiments in connection with the employment of d'Hérelle's method for the extermination of locusts in Algeria have been conducted by bacteriologists, but this year the possibility of its application being entrusted to laymen was recognised, while the bacteriologists only undertook the exaltation of the virus as well as the technique of preparation and spraying of virulent cultures. The locust invasion was especially serious in 1916 in Southern Oran, and some steppe country in this district was chosen for experiments.

The principle consisted in a very mobile body of men preparing the culture media themselves and receiving every day the exalted virus from the Pasteur Institute of Algeria. Details are then given as to how the broth was prepared in the field from concentrated products and inoculated with exalted virus. Twenty litres of broth could be prepared and sprayed each day while travelling about. One litre of a 36-hour culture was sprayed per hectare. The results of this campaign were briefly as follows:—

The coccobacillus produced an epizootic among locusts which, however, never led to the complete disappearance of the infected swarms. A marked destruction only took place when the experiments were performed a long time before metamorphosis occurred and when a large mass of insects all became infected on the day of the spraying.

The results were practically *nil* in alfa-grass districts where the pastures were too scanty. Propagation of the disease never extended appreciably for more than a kilometre from the direction followed by the locusts; a swarm moving through uniform country becomes sterilised. However, a veritable immobilisation of the sprayed swarms was produced even in cases where the epizootic assumed on great importance.

VELU (H.). **La lutte contre *Schistocerca peregrina* au Maroc en 1916 par la méthode biologique. Deuxième campagne d'expérimentation.** [Eradication of *Schistocerca peregrina* in Morocco in 1916 by the Biological Method. Second Experimental Campaign.]—*Bull. Soc. Path. Exot.* 1916. Nov. Vol. 9. No. 9. pp. 682–684.

The results of the preceding campaign in Morocco had shown that the conditions for success depended especially upon the season at which

the infections took place, the most favourable time being when the insects lived in a compact mass, moved slowly, and when "acridiophagia," the principal factor in infection, was at its highest.

An account of the movements of locusts in Morocco is given. All the swarms which passed in a certain direction were found contaminated with the coccobacillus, and hence the author deduces that (1) it is quite impossible to exalt the virulence of the American strain of coccobacillus preserved *in vitro* since July 1915; and (2) the locusts born at the time of the passage of infected swarms are contaminated.

Large quantities of virulent broth were sprayed in certain districts and the following observations were made.

The most favourable time for the infections is at the end of the third stage of the young locust (12 day old). In such cases a mass of dead bodies up to 10 cm. in thickness was found in certain places.

When the fourth stage (12 to 20 day old locusts) is reached the propagation of the infection is much less certain. The sick locusts are then left in the rear of the swarm and die separated away from other insects, and are thus lost for purposes of contagion.

When the period of the last moult is reached the locusts are submitted to more and more stringent sanitary laws which bring about the automatic elimination of germ carriers.

The last stages of larval life are thus not favourable for the application of the method, especially in open country.

(c) Sulphur Dips.

Chapin (R. M.). **The Chemical Composition of Lime-Sulphur Animal Dips.**—*U. S. Dept. Agric. Bull.* No. 451. Professional Paper. 1916. Dec. 14. 16 pp. Washington, D.C.

This paper furnishes another contribution to the literature on the subject of lime-sulphur solutions. Some additional knowledge on the subject is claimed to be furnished in this paper inasmuch as the writer "has been able to develop some new methods of analyses which appear in several ways superior to former ones."

The general plan of investigation, involving the preparation of solutions according to different formulae and under different conditions with subsequent analyses and comparison of results, consisted in experiments regarding the effect of storage, effect of lime added after dilution, effect of varying lime-sulphur ratio, effect of varying period of boiling, effect of varying concentration, occurrence and relations of calcium sulphite, ratio of polysulphide to thiosulphate, lower polysulphides and the effect of excess of lime, and higher polysulphides and the effect of oxidation.

General conclusions regarding the chemical aspect of the problem are then given.

The practical applications deduced from the data presented by these experiments are detailed as follows:—

"The subject has been dealt with by a number of investigators primarily interested in the preparation of such solutions for horticultural spraying purposes. Some of the formulas so developed seem to have given entire satisfaction for the purpose for which they were intended and the dilutions at which the resulting products should be employed under various

conditions have become so well established that any change in formula would be of doubtful practical benefit. It is quite otherwise with solutions intended primarily for the purpose of dipping cattle and sheep. The formulas in use are those prescribed by the Bureau of Animal Industry many years ago when uncertainty regarding possible chemical reactions and possible effects of the resulting compounds upon both animals and parasites very properly led to the use of formulas which should be certain and safe, even if somewhat uneconomical. The formula here to be suggested is proposed therefore solely for use as an animal dip. It may be termed the '8–18–10' formula; that is, 8 pounds of high grade commercial quicklime, 18 pounds of fine sulphur (either flowers or flour) with somewhat more than 10 gallons water, boiled to a volume of 10 gallons at the finish. The time of actual boiling should be one hour. The theoretical ratio between lime and sulphur will be met by this formula if the lime is 98·3 per cent. pure, therefore the formula as given is appropriate for preparing a solution for dipping sheep where any chance of an excess of lime must be avoided. If commercial hydrated (not air-slaked) lime is used the amount should be increased nearly one-third, say to 10·5 pounds. For dipping cattle the formula may be used on the basis of available calcium oxide if the analysis of the lime is known, or if not known the lime may safely be raised to 8·5 pounds, corresponding to 92·5 per cent available calcium oxide, possibly even to 9 pounds. The manipulation of the materials in the actual process of preparation has been described in a recent publication from the Bureau.*

"The finished solution, drawn off from the sediment should theoretically contain 18 per cent. (grams per 100 cc.) of sulphid sulphur, but probaby will contain somewhat less. It is, therefore, appropriate for dipping sheep at a dilution of 1 volume of concentrate to 9 or 10 volumes of water, and for cattle at a dilution of 1 volume of concentrate to 7 or 8 volumes of water. But in any event, since baths lose strength during dipping, it is very desirable to keep them at all times under control by means of a 'field test.'†

"The particular advantages of the above formula are, first, that it closely approaches the theoretical ratio, making allowance for impurities; second, it is as concentrated a product as can be prepared without conversion of thiosulphate to sulphite; and third, the figures are easily remembered and readily converted into the quantities of ingredients necessary to prepare a batch of any desired size.

"In deducing a formula for the preparation of highly concentrated proprietary solutions it is evident that the manufacturer must make a few trial runs with plenty of sulphur in order to establish the conditions which will uniformly yield the product he desires, analysis of which will then inform him by how much he may safely reduce the sulphur to allow for the formation of sulphite."

REPORTS.

ACCRA LABORATORY. **Report for the year 1915.** [MACFIE (J. W. Scott).] 101 pp. F'cap. With 6 plates. 1916. London: J. & A. Churchill.

This report contains a description of the routine work of the Accra Laboratory, Gold Coast; for the first six months of the year this was

* IMES (Marion). Sheep Scab.—*U.S. Dept. Agric.*, Farmers' Bull., 713. 36 pp. 1916. Washington.

† CHAPIN (R. M.). A Field Test for Lime-Sulphur Dipping Baths.—*U.S. Dept. Agric., Bull.* 163. 7 pp. 1915. Washington.

undertaken by MACFIE while for the second half of the year a summary of the work done is given by BROHIER (S.L.).

In addition, a list of the special papers published in various journals by Macfie is given, some of which have already been extracted in this *Bulletin*. A considerable number of further special investigations of importance are given in this report, references to some of which are made elsewhere in this number.

With regard to the routine examination carried out at the laboratory the following tables, reprinted from the report, are of veterinary interest:—

Trypanosome Infections found in Animals Slaughtered at Accra, January to June, 1915.

Host	Number examined.	Number with trypanosomes in the blood.	Percentage infected with trypanosomes.	Number infected with		
				T. vivax.	*T. congolense.*	*T. pecaudi.*
Cattle, humpbacked ..	48	45	93·7	33	14	6
Cattle, straightbacked ..	27	3	11·1	2	1	—
Sheep	33	1	3·0	1	—	—
Goats	29	1	3·4	1	1	—
Pigs	33	2	6·0	—	1	1
Totals ..	170	52	30·5	37	17	7

Babesia Infections found in Animals Slaughtered at Accra, January to June, 1915.

Host.	Number examined.	Number with Babesiasis.	Percentage with Babesiasis.	Number infected with	
				B. (T.) mutans.	*B. bigemina.*
Cattle, humpbacked	48	22	45·8	20	3
Cattle, straight backed	27	12	44·4	10	2
Sheep	33	8	24·2	8	—
Goats	29	—	0·0	—	—
Pigs	33	—	0·0	—	—
Totals	170	42	26·4	38	5

Examinations of Various Animals.

Animal.	Number examined.	Infections found.	Animal.	Number examined.	Infections found.
Bats	3	None.	Fish ..	1	None.
Birds :—			Hedgehog ..	1	None.
Fowls ..	8	None.	Lizards (*Ag. colonorum*)	2	*Haemogregarina* sp. in one.
Parrot ..	1	None.			
Small birds	3	None.	Mice	14	None.
Turkeys ..	4	*Halteridium* sp. in one ; and inclusions in the leucocytes in one.	Monkey ..	1	None.
			Rabbit ..	1	None.
			Rats :—		
			Brown ..	22	*T. lewisi* in two ; *Grahamella* in four ; *N. decumani* in four.
Cat	1	None.			
Crocodiles ..	3	*Haemogregarina* sp. in one.			
Dogs	4	*T. congolense* in one.	Pouched ..	4	*Grahamella* in three.
Equines :—			Snake ..	1	None.
Donkeys ..	1	*T. congolense.*	Toads (*Bufo regularis*) ..	11	*T. rotatorium* in ten ; *Haemogregarina* sp. in ten.
Horses ..	10	Trypanosomes of *T. congolense* type in five.			
Mules ..	17	Polymorphic trypanosomes ? *T. equiperdum* in two.	Tortoise ..	1	*Haemogregarina* sp.

An account of the parasitic infections found in the course of examining blood films obtained from the Accra slaughterhouse was given in the Annual Report of the Accra laboratory for the year 1914 [see this *Bulletin*, Vol. 4, No. 2, pp. 81–83] and an account of the occurrence of babesiases and trypanosomiasis at Accra has been published in the *Annals of Tropical Medicine and Parasitology*, 1915, Vol. 9 [see this *Bulletin*, Vol. 4, No. 1, pp. 6–9].

For the second half of the year the examinations of the blood of animals from the slaughterhouse (by BROHIER, S. L.) gave the following results as to the occurrence of trypanosomes :—

	Number examined.	Number infected.	Percentage.
Cattle	67	17	25·3%
Sheep	21	1	4·7%
Goats	22	—	—
Pigs	22	—	—
Totals	132	18	13·6%

"Examination of other animals.—Blood films from various animals were examined, but except in the case of 1 horse, 1 snake, and some rats, no parasites were found.

"The animals examined were 57 in number, viz., 1 pigeon, 1 cat, 1 dog, 1 duck, 1 horse, 3 hens, 1 cock, 1 sparrow, 1 bat, 3 snakes, 42 rats, and 1 hedgehog.

"Of the 42 rats examined six were found harbouring trypanosomes of the *T. lewisi* type, and three of the piroplasms alluded to in the last Annual Report as *Nuttallia decumani*.

"One case of equine filariasis was observed. The horse, the subject of this disease, was sent me by the police with a request for a report as to its fitness for work.

"The horse was emaciated; a watery discharge escaped from his nostrils; there was thickening and ulceration of the left lower eyelid at its inner angle, and a purulent discharge escaped from it. There was also a scanty purulent discharge from the right eye, but no signs of ulceration or of inflammation were present. The testicles were slightly enlarged and firm, the integument was thickened and honeycombed with shallow ulcers. Flies were constantly resting on these ulcers and apparently caused the unfortunate animal much discomfort.

"The coat was normal, but it was evident the animal had been greatly neglected, and several small shallow ulcers, mostly covered with scabs and abrasions were seen scattered over the body.

"An examination of the blood revealed numerous filarial embryos, very active, moving about with strikingly snake-like movements. No definite sheath could be made out, but the delicate transverse striation of the musculature of the body could be readily seen in specimens stained by dilute Giemsa. The anterior end was blunt, the posterior ending in a pointed whip-like tail. A definite clear space was noted between the anterior end and the commencement of the body nuclei; a clear collar-like space occurred about the point of junction of the anterior third with the posterior two-thirds of the body; and shortly behind the collar-like spaces a diamond-shaped orifice could be seen. A differential leucocyte count gave the following percentages:—polymorphs, 52%; large monos, 4%; eosinophiles, nil; large lymphos, 12%; small lymphos, 30%; hyaline and transit, 2%.

"Although examined for periodicity, none was apparent. The microfilariae were present in films taken in the day-time as well as in those taken at night; if anything the number was slightly greater in the films taken in the day-time.

"Ten days later the most noticeable feature was the presence of a large island of oedema over the most dependent parts of the abdomen, and the owner stated that when kept in the stall the legs became swollen. The testicles had greatly diminished in size, the integument was nearly normal, and the coat had greatly improved, though ticks were still found in the flexures and in the ears. The eye condition was, if anything, rather worse. Microfilariae were still present. Inoculations of the blood into guinea-pigs and rats were negative. At this stage the differential leucocyte count was as follows:—polymorphs, 68%; large monos, 2%; eosinophiles, 10%; large lymphos, 12%; small lymphos, 7%; basophiles, 1%.

"Some of the clinical features of this case were suggestive of trypanosomiasis, but no trypanosomes were found in the blood, although there was some degree of auto-agglutination of the red corpuscles in the specimens examined. It is impossible to say to what extent the symptoms described may have been due to filariasis."

BRITISH EAST AFRICA. **Department of Agriculture. Annual Report of the Veterinary Department for the Year ending 31st March 1915.** [STORDY (R. J.), Chief Veterinary Officer.]—pp. 115–124. 1916. Nairobi, British East Africa: Swift Press.

Diseases of Cattle. East Coast Fever.—Nine outbreaks occurred during the year. There are now 70 dipping tanks in good working order throughout the country, and the good results obtained by their use have convinced the settler community of the efficacy of regular dipping at three-day intervals as a preventive against East Coast fever. Several more dipping tanks are being constructed and the view is held that it is only by universal dipping that the suppression of East Coast

fever can ever be anticipated. Some remarks on the forwarding of samples of dip for chemical analysis are included.

Rinderpest.—Twelve outbreaks of this disease occurred on European-owned farms. The disease is enzootic throughout most of the native reserves and owing to illicit movements of cattle from these reserves many outbreaks have occurred in the settled districts in the neighbourhood of these areas. It has been found possible to deal only with outbreaks affecting European-owned cattle. Double inoculation has thus been carried out on an extensive scale in many districts with most satisfactory results. The average mortality has been less than one per cent. More than 35,000 military cattle have been doubly inoculated since the war began.

230,384 doses of serum were sent out by the laboratory during the year, the greater part of which was exported to other countries.

Anthrax.—This assumed the form of an epizootic in two districts, the sudden increase of the disease being attributed to the shortage of grazing throughout the country resulting in cattle being compelled to graze closely and thus ingest considerable quantities of infected soil. 23,000 doses of anti-anthrax serum, prepared at the laboratory, were issued with most beneficial results. Unfortunately the vaccine in one case had regained its virulence and resulted in a number of animals succumbing to the disease.

Pleuro-pneumonia.—A recrudescence occurred in the Masai reserve in April. The cattle in five infected villages were quarantined, but the mortality was not large.

There were no cases of tuberculosis. Three outbreaks of blackquarter occurred and this disease appears to be on the increase.

Diseases of the Horse. Epizootic and *Ulcerative Lymphangites* were discovered in districts adjacent to the railway before the war. After the outbreak of war horses and mules were commandeered throughout the country and ulcerative lymphangitis was found to be existent among equines to a wholly unexpected extent.

Horse Sickness.—Fifty-six cases were reported and most of these occurred in Nairobi. The mortality from this disease has not been large for some years, and it is hoped that with better stabling of animals, etc., the death-rate will never reach the high percentage recorded in South Africa.

Sheep scab is ubiquitous, and while the hairy native sheep suffers little the causal parasite has disastrous effects on the wooled animal.

Goats.—Pleuro-pneumonia is widespread in the native reserves.

Pigs.—In order to eliminate the danger of infection with swine fever from wild porcines several farms have fenced their pig runs with wire netting.

" There is no country in the world where pigs can be reared so cheaply, and pig breeding is rapidly becoming one of the most lucrative industries of the Protectorate."

Dogs.—No cases of rabies occurred during the year.

Ostriches.—Castration was undertaken by the Veterinary Department.

Poultry.—Kikuyu fowl disease, an extremely acute form of fowl cholera has been the cause of large mortality in different parts of the country.

Details are added concerning the permit system, which acts as a check on the movement of native cattle, live stock importations, meat inspection, trading, and branding of stock; also an account of the co-operation of the Veterinary Department with the Military authorities since the outbreak of war is given.

British East Africa. **Department of Agriculture. Annual Report of the Veterinary Bacteriologist for the Year 1914–1915.** [Montgomery (R.E.).]—pp. 125–145. 1916. Nairobi. British East Africa: Swift Press.

The routine work of the laboratory consisted in examinations of slides and smears received from government officials and private owners, and in serum and vaccine preparation. The latter part of the work included the preparation of anti-rinderpest serum (274,368 doses), anthrax vaccine (32,180 doses), blackquarter vaccine (9,400 doses), colon bacillosis vaccine (701 doses), ulcerative lymphangitis vaccine (2,923 doses), and canine trypanblau (269 doses).

Diseases under Observation.

Anthrax.—See report of Chief Veterinary Officer.

Trypanosomiasis.—160 cases of the disease were diagnosed (105 in cattle, 52 in equines, and 3 in dogs). This represents a large increase over previous years and is due to the greater movement of susceptible animals within the areas inhabited by the tsetse fly. Large numbers of military animals were available for experimental treatment. The author believes that the number of diseases grouped under the name of trypanosomiasis or fly disease in the Protectorate is at least ten, the causal agents of which are distinct from a zoological point of view, and they differ in that recovery from the disease due to one type of trypanosome does not confer immunity against infection by another. Experiments were conducted with such drugs as 606, galyl, atoxyl, soamin mercury, tartar emetic, and arsenic in various forms and various combinations. No good results whatever were obtained, animals which had apparently recovered being still infective. Holmes's method of treatment for Indian surra was applied in the treatment of a number of cases, but not one recovered.

Helminthiasis.—Experimental work on the wire worm infection of sheep appeared to show that land will remain infective for at least 12 months after the removal of all sheep, and also that sheep may retain worms in their stomachs for at least six months although fed with artificial foods.

Considerable mortality has been experienced among cattle and these, on post-mortem examination, were found to contain a large number of worms in the fourth stomach. Experiments are being carried out to determine whether the infection of cattle is identical with that of sheep. Lysol has given the most uniform results in treatment; the dose now given is 8 ozs. of a 5 per cent. solution administered in the form of a drench on four successive mornings.

A worm invasion of the stomach of equines due to the genus Spiroptera was frequently encountered and it is believed that lysol administered in these cases produces a marked amelioration in the condition. Donkeys were especially found infected.

Oesophagostomum columbianum appeared to be the cause of serious mortality in young sheep in the case of one outbreak.

Diseases affecting Equines.

Ulcerative lymphangitis, due to the Preisz-Nocard bacillus, was diagnosed in 83 cases, the symptoms varying in intensity from an insignificant pustule to abscesses covering the whole of the body. On the Uasin Gishu plateau, where the disease is prevalent, it commences with the formation of one or more abscesses around the fetlocks, more particularly on the hind legs and spreads upwards towards the thighs and over the body, and in cases which end fatally internal abscesses about the size of a child's head are often found situated near one or both kidneys. In chronic cases a peculiar scab-like formation resembling a warty growth forms on the localised abscesses and microscopic examination of these scabs invariably revealed the presence of a streptothrix organism.

Successful results were claimed to have been obtained in the laboratory following treatment by means of weekly injections of a vaccine made from the Preisz-Nocard bacillus. A large quantity of this vaccine, however, when tried in the case of an outbreak of the disease in a certain district, failed to give satisfactory results.

Epizootic lymphangitis.—Thirty-one military animals were available for experimental treatment and over 20 privately owned animals and mules. The disease appears to be confounded with the last described disease due to the Preisz-Nocard bacillus. The results of treatment with "606" were good, but the expense of this drug makes it prohibitive except in exceptional cases. Mercurial cream failed to give the good results hoped for. The administration of potassium iodide either alone or in combination with biniodide of mercury yielded results which left little to be desired. In order to ensure success animals must receive a dose every day for approximately a month. The routine practice employed consists in the administration of half an ounce of potassium iodide and 5 grains of biniodide of mercury each morning in the drinking water, the supply of green grass and water being curtailed until the full dose has been drunk. Even in advanced cases of the disease a marked drying of all lesions is apparent after about the seventh dose. The thickening of the lymphatic cords decreases, nodulation disappears, and, in about a month, the animal, unless in a very advanced stage at the commencement, will fail to show any outward trace of the disorder.

Infectious Anaemia.—This disease is strongly suspected as being the cause of heavy mortality among donkeys and experiments are in progress in order to determine whether this is the case.

Horse Sickness.—"That true Horse Sickness does exist in East Africa is clear but the results which have been obtained by Sir Arnold Theiler with specimens of blood forwarded to him for experiment demonstrated that only a percentage of the suspected cases are affected with it."

Diseases of Cattle.

Rinderpest.—No experimental work was performed during the year; the manufacture of anti-serum has been referred to above. The virulent blood used in the double inoculation had to be maintained in

the laboratory, and either used within 48 hours of dispatch or an infected susceptible animal was forwarded and its blood employed for the immunisations.

East Coast Fever.—With the establishment of dipping this disease no longer calls for much further experimentation, for if an owner regularly dips in a dipping fluid of standard strength his losses even during the first year will be very considerably reduced and after that period it is probable that all infected ticks will have been eradicated.

Statistics are given with regard to the cost of dipping, etc. During 12 months' use 41,712 cattle, 2,608 equines, and 5,914 sheep and goats were passed through the laboratory dipping-tank. The total amount of dipping fluid used was 27,586 gallons. WATKIN-PITCHFORD'S laboratory formula was adopted in the manufacture of the dipping fluid. Each 100 gallons for the three-day dipping thus contained:—Arsenite of soda (80 per cent. arsenic) 1 lb., soft soap $\frac{3}{4}$ lb., paraffin 2 lb. The cost of material worked out at 55·9 cents. per animal per annum.

Redwater and anaplasmosis.—Although dipping will eradicate both these tick-borne diseases from a farm it was sometimes found necessary to expose imported and other highly susceptible stock to areas which it had not yet been found possible to cleanse. A strain of anaplasma obtained from THEILER for the purpose of immunising such animals was found to be too strong to be tolerated with safety. With each successive passage the strain appeared to become markedly increased in virulence.

The blood of Uganda cattle was found to contain the causal organism of both redwater and anaplasmosis, and when inoculated into susceptible animals in doses of cc. induced a mild infection with redwater between the 8th and 12th day and anaplasmosis between the 20th and 50th day. The former reaction, if severe, was easily checked by means of trypanblau. It was noticed in the case of cattle from South Africa that the (second) reactions occurred between the 20th and 30th day, whereas in the case of stock from England the earliest reaction began on the 36th day and the latest on the 53rd day.

Of 15 shorthorns imported from England and immunised against rinderpest, redwater, and anaplasmosis by a single injection of Uganda blood in which the rinderpest virus was present, two died from anaplasmosis, the reactions to redwater and rinderpest being normal. Of four South African cattle immunised in the same way one died from anaplasmosis.

Colon bacillosis.—A vaccine made from the incriminated organism was issued to a number of stockowners for tests in the field, the method consisting in the injection of 5 cc. of emulsion containing 2,000 million of dead bacteria subcutaneously as soon after birth as possible. Reports were received which seemed to indicate that strikingly beneficial results have been obtained.

Blackquarter.—This disease had become more prominent during the year; 5,000 doses of a single vaccine were issued and in most cases it was claimed that the vaccination was responsible for checking the mortality. In one instance a considerable number of calves succumbed to infection following inoculation, although the vaccine in this case had apparently been rigidly tested prior to issue.

Contagious abortion.—This occurs on several farms, but no increase has been noted. The agglutination test has been employed in diagnosis.

Disease "C.H."—In the course of an epizootic resembling a mild outbreak of rinderpest a specimen of blood was tested and shown to be capable of infecting cattle immune from rinderpest, and that susceptible animals recovered from this disease might still be infected with rinderpest. The symptoms manifested were dulness, slight depression, and a high temperature lasting three or four days, accompanied with a dark foetid diarrhoea which later changed to constipation. There was some discharge from the eyes and occasionally the membranes of the mouth were somewhat inflamed. In calves the inoculation produced a more severe reaction than in adults. In Indian buffaloes the reaction produced was more severe than in calves and the affected animals showed such extreme depression that death appeared imminent although all recovered. Mules were found to harbour the virus in their blood from about the 6th to the 10th day after inoculation, although no symptoms were shown; five animals out of 43 inoculated died.

One attack of the disease confers an immunity which lasts three months. The virus appears to live in the blood corpuscles, serum is not virulent and the organisms do not appear to pass through either a Chamberland or a Berkefeld filter. Defibrinated blood loses its virulence in about a week. Attempts to reproduce the disease by contact failed. An anti-serum was made by hyper-immunising cattle with large doses of virulent blood.

Diseases of Sheep and Goats.

Nairobi sheep disease.—This has been responsible for considerable trouble at some of the military supply camps. It was proved that ticks of the species *Rhipicephalus appendiculatus* can transmit the infection as adults, after having been fed as nymphae on a sick animal.

Pleuro-pneumonia in goats.—This occurred in the form of a serious epizootic throughout the Protectorate in September 1914. It was possible neither to ascertain the causal organism, nor experimentally to infect healthy animals.

Diseases of Pigs.

Swine fever.—No outbreak of the East African form of the disease was reported during the year. The Uganda bush pig was shown to be immune to this disease; owing to the devastation caused by these animals in the native habitations an attempt at eradication had been made by trying to transmit this infection to them.

Diseases of Poultry.

Kikuyu fowl disease.—109 cases of this disease were diagnosed in the laboratory. Although the causal organism differs from that of fowl cholera it resembles it in that its virulence becomes lost with age. The preparation of a preventive vaccine was therefore made possible, but this has not yet been extensively applied in the field.

MUKTESAR LABORATORIES. **Annual Report of the Imperial Bacteriologist, for the Year ending 31st March 1916.** [SHILSTON (A. W.), Assistant Bacteriologist in charge]. 23 pp. 1916. Calcutta: Superintendent Government Printing. India. [Price 5*d.*]

This report deals with (1) administration, (2) preparation of sera and vaccines, (3) research work. Tables are appended showing the

quantities of different products issued from the laboratory, and the main results of the working of the laboratory for the year.

Under the heading of preparation of vaccines a number of figures are given which are specially valuable on account of the very large scale in which these products were employed. Tables are given showing the number of outbreaks, etc., dealt with by the administration of these products in the various provinces. The table on the following page gives a résumé of the total results achieved.

The other products manufactured were anti-strangles serum and vaccine, mallein, a small quantity of tuberculin, and small quantities of various miscellaneous vaccines.

The results of examination of specimens received are given.

Research work.—Some general remarks are given with regard to this part of the work ; no details are entered into, but the publication of the results of experiments is promised with regard to (1) observations on the preservation of rinderpest virus, (2) the immunising effect of dead vaccines in the case of anthrax and haemorrhagic septicaemia, and the standardisation of the anti-sera of these diseases [MACALISTER (G. H. K.)], (3) kumri, (4) the causal organism of abortion amongst mares and donkeys, (5) investigation of the transmission of surra by biting flies (HOWLETT).

Investigations into the drug treatment of rinderpest have been discontinued owing to the invariably unsatisfactory results obtained. It is stated that the value of both anti-serum and vaccines in the treatment of strangles among horses at two Army Remount Depots was frequently demonstrated.

The results of experiments performed with the object of increasing the output of serum and effecting economies in the course of its production have already been referred to in this *Bulletin* [see Vol. 4, No. 4, pp. 188–190 (NORRIS, R. V.)].

NIGERIA. **Annual Reports of the Agricultural Departments of Nigeria for the Year 1915.** 13 + 11 pp. 1916. Lagos : Govt. Printer. [Veterinary Report for the Year 1915.] [BRANDT (F. R.).] Appendix 1. pp. 5–7.]

On account of small staff employed the work has been rather limited, and has consisted mainly in tours with the object of instructing native cattle owners and obtaining information with regard to stock, grazing, water, and movements.

Rinderpest.—This appears to be the most important disease, but the mortality sometimes seems to be exceptionally low, varying from 5 up to 50 per cent., the latter figure being exceptional. Cases were seen in the early part of the year in Kano, Bornu, and Bauchi. It was found to be widespread in Sokoto Province as well as in French West Africa, where the disease appeared to be assuming a more virulent type. In June it was found to be again prevalent in Bauchi. In July the disease was found to have extended down the left bank of the Benue River to Muri.

No report of an outbreak of the disease was received during the latter part of the year. The disease thus followed a course which would lead one to suspect the possibility of its having been present for a long time in an endemic form, but of a character so mild as to have been

Table showing results of use of serums and vaccines issued from the Muktesar Laboratory.

Serum or Vaccin.	Number of outbreaks in which inoculation undertaken.	Number of animals which died un-inoculated in course of disease.			Number of animals inoculated.			Number of animals which died after inoculation.		
		Equines.	Bovines.	Others.	Equines.	Bovines.	Others.	Equines.	Bovines.	Others.
Anti-rinderpest serum ..	2,662	*Nil*	43,058	168	*Nil*	396,293	1,184	13*	2,765	6
Haemorrhagic septicaemia serum and vaccin ..	518	1	2,769	*Nil*	7	89,641	14	*Nil*	76	*Nil*
Anti-anthrax serum ..	118	33	861	401	769	12,541	558	1	27	*Nil*
Blackquarter (Charbon symptomatique) vaccin ..	94	*Nil*	274	*Nil*	*Nil*	9,168	*Nil*	*Nil*	14	*Nil*

* This is apparently an error.

overlooked by the stock owners until 1914, when by a slight increase in virulence a high death-rate resulted. The natives, however, state that this is the first time that the disease has appeared since the outbreak of about 25 years ago.

No inoculations seem to have been performed.

Pleuro-pneumonia.—Prevalent throughout the country.

Foot-and-mouth disease.—Is widespread but the mortality is not high.

Anthrax and *Blackquarter* appear especially towards the end of the dry season.

Trypanosomiasis.—Is found in every province, but is not extensive in the northern stock-raising areas, where most of the fly belts are known and avoided as much as possible.

NIGERIA. **Annual Report of Medical Research Institute 1915.**—[CONNAL (A.) & SINCLAIR COGHILL (H.).] 28 pp. f'cap. 1916. London: Crown Agents for the Colonies. [Price 2*s.* 6*d.*].

The following paragraphs of veterinary interest are reprinted from this report:—

Babesiasis.

"By the request of the Principal Medical Officer, a number of blood smears from domestic animals were sent to the Institute to be examined for the presence of babesiae." . . .

"In all, the blood of 332 animals was examined. Babesiae were noted in 10 out of 168 cattle, in one out of 66 goats, in eight out of 44 sheep and in three out of 21 dogs; no babesiae were observed in 28 pigs, four horses and one cat." . . .

Blood-sucking Flies.

"The insects enumerated were all obtained in the immediate neighbourhood of Yaba.

"Three specimens of *Glossina palpalis*, females, and two of *Stomoxys nigra* were caught in the laboratory in April.

"During May *Glossina palpalis* 18 ♀, *Stomoxys nigra* 8 ♀, *Tabanus secedens* 3 ♀, *Stomoxys omega* 2 ♀, *Tabanus socialis* 2 ♀, *Hippocentrum versicolor* 2 ♀, *Tabanus thoracinus* 1 ♀, and *Tabanus fasciatus* 1 ♀ were obtained." . . .

"During June *Glossina palpalis* 10 ♀ were taken, also *Stomoxys nigra* 28 ♀, *Stomoxys omega* 2 ♀, *Tabanus secedens* 1 ♀, *Hippocentrum versicolor* 1 ♀ and *Glossina tachinoides* 1 ♀." . . .

"In July *Glossina palpalis* 11 ♀ were captured, also *Mansonioides africanus* 4 ♀, *Anopheles costalis* 1 ♀ and *Anopheles mauritianus* 1 ♀.

"Only *Glossina palpalis* 1 ♀ was obtained in August, but three were taken in September, as well as one female specimen each of *Tabanus socialis* and *Tabanus taeniola.*

"During October, *Glossina palpalis* 3 ♀, *Tabanus taeniola* 4 ♀ and one *Tabanus socialis* ♀ were captured.

"In November there were *Glossina palpalis* 1 ♀, *Tabanus taeniola* 3 ♀, *Tabanus par* 1 ♀, *Tabanus kingsleyi* 1 ♀ and *Tabanus secedens* 1 ♀, and in December one female *Glossina palpalis* was caught.

"The total blood-sucking insects caught and identified was 535, and of this number 320 were dissected and examined.

"Smears were made of (*a*) proboscis, (*b*) cephalic muscles, (*c*) thoracic muscles and (*d*) intestinal tract. In most cases these smears were examined in the fresh as well as in the stained condition.

"During the earlier period of the investigation attempts were made to feed the insects, particularly the glossina, on clean guinea pigs, but this procedure was soon given up as it occupied too much time, and also because many insects which would not feed on the day on which they were caught were found dead next day and therefore had to be discarded altogether.

This occurred most commonly in the case of the glossinae, and the inference was made that these flies were not locally hatched, but had come with the trains (which pass close to the Laboratory) and were spent and bruised by their journey.

"Smears were examined from 47 *Glossina palpalis*. Trypanosomes were found in the proboscis of two and in the stomach of another two. Spirochaetes occurred in one. Mammalian red blood cells were noted in the stomach of five, avian red cells in one, and filarial embryos were observed in one of the five that had ingested mammalian blood. The remaining 37 insects showed nothing noteworthy. The trypanosome-infected flies were caught one in April, two in June and one in November.

"One specimen of *Glossina tachinoides* was examined with negative results.

"Smears from 18 *Stomoxys nigra* and from four *Stomoxys omega* were examined. The only interesting result was the findings of avian red blood corpuscles in the stomach of one *Stomoxys nigra*. These insects, however, were caught mostly newly hatched from the garden manure.

"Specimens of seven species of Tabanus, *T. taeniola* (8), *T. secedens* (5), *T. socialis* (4) and one each of *T. par*, *T. fasciatus*, *T. kingsleyi* and *T. thoracinus*, a total of 21 were dissected. Herpetomonas were observed in the intestinal tract of one *T. secedens*.

"Two specimens of *Hippocentrum versicolor* showed nothing of interest." . . .

"Trypanosomes were found in four specimens of *Glossina palpalis* (47 examined).

"Herpetomonas were noted in the intestinal tract of three *Culiciomyia nebulosa* (112 examined), one *Ochlerotatus nigricephalus* (31 examined) and one *Tabanus secedens* (five examined).

"Spirochaetes were observed in three *Culiciomyia nebulosa* (112 examined), one *Mansonioides africanus* (23 examined), one *Ochlerotatus irritans* (22 examined), and in one *Glossina palpalis* (47 examined)." . . .

"The trypanosome-infected glossinae were caught in April, June and November. The spirochaete-infected glossina was caught in June, the culiciomyiae, the Mansonioides and the ochlerotatus in May. The filaria-infected culiciomyia and the anopheles were both caught in May." . . .

"Mammalian blood had formed the meal in five *Glossina palpalis*, twelve *Anopheles costalis*, one *Anopheles mauritianus*, six *Mansonioides africanus*, seven *Culiciomyia nebulosa*, 17 *Ochlerotatus nigricephalus*, 10 *Ochlerotatus irritans*, one *Stegomyia fasciata* and one *Stegomyia luteocephala*.

"Avian blood had been ingested by one *Glossina palpalis*, one *Stomoxys nigra*, and 27 *Culiciomyia nebulosa*.

Both mammalian and avian erythrocytes were found in the stomach of two *Culiciomyia nebulosa*, one *Anopheles costalis* and one *Stegomyia luteocephala*.

"It would appear from these results that *Culiciomyia nebulosa* prefers avian to mammalian blood." . . .

Trypanosomiasis.

"Many of the blood smears from domestic animals showed trypanosomes, cows, sheep, goats, horses, pigs and dogs were all found infected.

"Cattle and horses appear to be especially prone to the disease, probably because they are more frequently to be found outside the immediate environs of a town or village than the other animals, and so are more exposed to the bites of tsetse.

"Blood smears from 168 cattle were examined. They were all sent to the Institute in the dried state. Trypanosomes were found in 49, that is 29·1 per cent. So far as could be judged most of the parasites were *T. vivax*, and a few resembled *T. pecaudi* (*T. brucei*).

"A single goat out of 66 examined showed trypanosomes, the parasite resembling *T. vivax*.

"Forty-four sheep were examined and trypanosomes were found in one, the species being apparently *T. vivax*.

"Three pigs out of 28 were found to harbour trypanosomes, resembling *T. pecorum* (*T. congolense*).

"Blood smears from 21 dogs showed trypanosomes of the *T. pecaudi* (*T. brucei*) type in two cases.

"Four horses were examined and trypanosomes of the *T. vivax* type occurred in two.

"One cat was examined, with negative result.

"The infection was mostly a heavy one in the cattle, horses and dogs, and a scanty one in pigs, sheep and goats." . . .

"Various blood smears from 23 snakes, mostly harmless green or brown colubrines, were examined in a search for the pigment-bearing parasites which have been described from a few of the cold-blooded animals. Haemogregarines were found in six. Haemoproteus or plasmodia were not found in any, although in two of the animals a few of the leucocytes contained pigment granules.

"Other cold-blooded animals examined were 3 fish, 2 frogs, 1 toad, 1 crocodile, 1 turtle and 4 small tortoises. Parasites were only found in one animal, the turtle, and these were haemogregarines.

"A variety of other animals was examined. Out of nine different birds, one, a small heron, harboured trypanosomes. Ten mice showed no blood parasites. Out of seven rats, *T. lewisi* was noted in four and *Grahamella* in one.

"Seven monkeys, 4 bats, 2 pottos and 1 porcupine were examined with negative results." . .

Vaccine Lymph.

"The following experiments were carried out at the request of the Director of the Medical and Sanitary Service with the object of ascertaining whether there would be any danger in employing cattle, suffering from an infection of trypanosomiasis or babesiasis, in the manufacture of small-pox lymph; in other words, whether or not these parasites in some latent form or other could be transmitted to people vaccinated with lymph prepared from cattle harbouring these same parasites.

"After several visits had been paid to the cattle market at Ebute Metta, two young cows were finally chosen—one infected with trypanosomes and the other with babesiae.

"Three attempts were made to vaccinate these but without success, Dr. Mackey kindly helping on the first two occasions. Finally both animals died. Again two similar cows were procured and a fresh supply of lymph was tried; this met with success and after some difficulty lymph was taken from both. Owing to the weak condition of these animals they had to be allowed a good deal of liberty, and the difficulty arose how to prevent them from rubbing or scratching themselves and so rendering the experiment useless as far as they themselves were concerned.

"Two monkeys, whose blood had previously been examined, were vaccinated successfully with this lymph. After the first day their temperatures were taken morning and evening every second day for three weeks and at irregular intervals following. Two months afterwards their blood was examined for the last time. No parasites of any sort were found, and their temperatures were normal throughout.

"A portion of the lymph was examined microscopically, and also added to the water of condensation of three agar tubes. The result in both cases was negative."

PUNJAB. **Annual Report of the Camel Specialist for the Year 1915-1916** [CROSS (H. E.).]—27 pp. f'cap. 1916. Lahore: Superintendent. Government Printing. Punjab.

This interesting report commences by giving tabulated summaries of the mortality returns sent in by the various Camel Corps under observation; as the author states, too much reliance cannot be placed on these returns as they were compiled largely from the statements of camelmen, yet they give a very good idea as regards the relative prevalence of certain camel diseases.

The total losses from deaths, and castings amongst the eight Silladar Corps, four Grantee Camel Corps, and the Local Transport, Dera Ismail Kahn, Bannu and Kurram Valley Militia were 2,800 = 25·4 per cent., whereas the total losses from deaths alone were 2,500 = 22·7 per cent.

The most noteworthy disease was surra; the number of cases diagnosed during the year was 1,593, and it is considered that the number in reality considerably exceeded this figure owing to the disease in various forms, especially when accompanied by brain symptoms, being wrongly diagnosed.

Experimental Work.

Anti-fly emulsion experiments.—Details are given with regard to experiments conducted in smearing or spraying camels with various emulsions in places where surra was known to exist and where blood-sucking flies were prevalent.

The conclusions with regard to these various experiments are reproduced as follows :—

Creosol emulsion. Consisting of creosol, 1 oz.; pix liquida, 2 oz.; soft soap, 8 oz.; water, 3 pints.

"(1) Three pints of this emulsion are scarcely sufficient.

"(2) If the animals are kept in the shade the emulsion would appear to have some slight efficacy in warding off the attacks of Tabanidae.

"(3) After 12–13 hours the emulsion did not prevent the Tabanidae from biting.

"(4) If the animals are sprayed and kept in the sun the emulsion prevented Tabanidae from biting for half an hour only.

"(5) As soon as the emulsion has dried on the skin it does not appear to have the slightest efficacy against the attacks of Tabanidae."

Jensen's emulsion. (Kerosene oil, 1 gall.; powdered naphthaline, 4 ozs.; soap, 1 lb.; water, 4 galls.). At the time when these experiments were carried out the camels had little or no hair, and the sun was very powerful.

"(1) This emulsion prevents Tabanidae from biting for 12 hours.

"(2) The emulsion cannot be recommended for camels as it causes severe blistering of the skin."

Citronella oil. "This prevents Tabanidae and Stomoxys from attacking for a few hours, but it has no repellent action after 17 hours."

Cod-liver oil. "This does not prevent Stomoxys and Tabanidae attacking camels."

Aniseed oil. "(1) Tabanidae appeared on the sprayed and unsprayed camels at the same time. Aniseed has no repellent action against Tabanidae 2½ hours after application.

"(2) It has a slight repellent action against Stomoxys; the length of time it prevents Stomoxys from biting is so short that the oil cannot be considered to be of any practical value in warding off the attacks of the biting flies.

"(3) The application of only one pint causes great restlessness in the camel."

Castor oil. Four separate experiments were performed with castor oil and castor oil emulsion.

"The result obtained with 4 pints (which prevented Stomoxys and Tabanidae from biting for three days) was very different from that obtained with 3 pints (which prevented Tabanidae from biting a camel for 1 hour only), but I do not think it is due to the extra pint of oil used. At this time of the year the quantity of hair on camels varies greatly. The camel that was smeared with 3 pints had practically no hair, whereas both camels that were smeared with 4 pints had a fair quantity of hair. The matting of the hair by the oil might explain why the Tabanidae did not attack those parts where there is hair, but it does not explain why the Tabanidae did not attack the camels smeared with 4 pints on the sheath, etc., where there is never any hair on camels. In experiments with repellents for protecting

animals from the attacks of Tabanidae and other biting flies the results obtained depend to a great extent on whether the flies are very hungry or not.

"Castor oil is of no practical value on account of the cost. Smearing a camel with 4 pints costs over Rs.2–8–0."

Blackquarter.—In order to determine whether camels are susceptible to this disease three camels were inoculated with blackquarter virus, one young buffalo and one calf acting as controls. The results indicated that camels are as susceptible to blackquarter as bovines, and that the symptoms of blackquarter in camels are identical with those in bovines.

Haemorrhagic Septicaemia.—This disease causes a very large number of deaths in India amongst bovines; in order to determine whether camels are susceptible to this disease, two camels were inoculated with 2 cc. of culture, and two goats and two rabbits acted as controls. The results of these experiments appear to indicate that camels are not susceptible to haemorrhagic septicaemia.

Rinderpest.—Experiments to test the susceptibility of camels to rinderpest gave no result as the blood inoculated proved to be avirulent for control cattle.

Feeding experiments.—The average amounts of green fodder and water that can be ingested daily by a camel at rest when given a certain quantity of concentrated food were determined. It was found that:—

"(1) The average amount of green taramira that a camel will eat, when doing no work and receiving 6 lbs. of gram, is 66 lbs.

"(2) The average daily amount of water that a camel will drink when fed on green fodder and when the temperature is not high and doing no work is 2¼ gallons.

"(3) The average daily amount of water drunk by one camel, fed on gram and missa bhoosa, and doing ordinary work, was 5 gallons. When ridden on 2 successive days 14 miles (in the month of March when the temperature was not very high) the amount of water drunk was 9½ and 8 gallons, respectively."

Further experiments in this direction will be undertaken next year.

Sore throat.—Details are given with regard to the history of one case of this disease, which appears to be fairly prevalent in camels. Nothing appears to be known as regards the etiology. It is stated that until the cause of the disease is determined all that can be done is to treat the symptoms.

"A dose of Epsom salts, 1–2 lbs. (according to the size of the animal) should be given at once. Fomentations may be applied to the throat, and green fodder placed in front of the animal. The animal should be placed in the shade and left alone. On no account should the camel be worried by allowing the camelmen to force food down its throat.

"Camelmen fire the throat and maintain that if this is not done the animal in every case dies; but if the throat is fired a number of cases recover."

Jhooling or *Jhoolak.*—"This is a contagious disease of camels manifesting itself in the formation of local tumours—hot and painful, of a fibrous character, and terminating in suppuration and raw patches." It is widely distributed throughout the Punjab and usually occurs in the cold weather; the etiology is unknown. Horses, cattle, buffaloes, dogs, guinea-pigs and rabbits appear to be immune, but the disease is easily transmissible by contact to healthy camels. Examination of the pus of the abscesses reveals the presence of streptococci.

Treatment consists in the excision of the lesion or the application of a blister in order to hasten abscess formation. The lesions heal up, leaving on the skin small white spots which last several months. With regard to preventive treatment it is advised that no camel should be bought if it presents such spots; also when a case occurs strict isolation should be enforced.

Rheumatism.—Camels suffer a great deal from articular rheumatism. No cases of muscular rheumatism were observed. The disease is very prevalent in all parts of the Punjab and appears to be caused by bad hygienic conditions, such as improper feeding, cold and damp, and apparently also by feeding on shisham leaves.

Wail.—This disease is common in one part of the Punjab and is characterised by loss of control of the hind legs with consequent difficulty in sitting down and getting up, thus resembling those of kumree in horses. The etiology is unknown, but the disease is probably due to grazing continuously on lana. Inoculation of blood into camels and other animals gave negative results. No therapeutic treatment proved beneficial.

A small experiment on dachi's milk indicated that " butter can be made from camel's milk," but that " it takes four times as long to get butter from camel's milk as from cow's milk."

Surra.—No attempts were made to treat camels by Commandants of the various Camel Corps except in one instance, where excellent results were obtained by the administration of arsenic alone and a combination of arsenic and soamin. The figures in this instance were as follows:—Total number of camels treated 158, number of camels cured 129, number of camels died under treatment 29, number of relapses nil.

Further experiments were carried out in connection with treatment; the following are briefly the results:—

(1) *Alternate doses of mercury perchloride and chinosol* administered intravenously (4 times altogether) apparently appeared to have effected a cure in the case of five diseased camels after from 13 to 15 days from the commencement of the treatment. Relapses, however, occurred in all cases between the 10th and 28th day after the last dose of chinosol. It is concluded that alternate doses of these drugs given intravenously in as large doses as can be tolerated have no curative action against surra.

(2) *Alternate doses of iodine and soamin* with intervals of one day between each dose did not give satisfactory results.

(3) *Alternate doses of iodine and mercury perchloride* gave very unsatisfactory results.

It is stated that a variety of other drugs were tried, none of which gave satisfactory results.

Experiments were carried out with regard to the course that surra runs in the camel and also in ponies. The camel experiments are apparently not yet completed. It was found that ponies are susceptible to camel surra, but that the course which the disease runs in old and in young ponies is very different. The same difference is noticed when old and young camels are inoculated with surra. In the case of old camels death takes place rapidly whereas in one year old camels the disease does not run a rapid course. Surra may produce cerebral symptoms in ponies and these symptoms are also seen at times in camels suffering from the disease. Pus in the sinuses may be produced. Surra does not always cause emaciation.

In the case of two goats inoculated with camel surra, although no trypanosomes could be observed in the peripheral circulation of either goat, blood was shown to be infective; when 1 cc. of blood was injected (126 days after the goats were inoculated with camel surra) into rabbits and guinea-pigs, these animals developed surra.

Three sheep were inoculated with blood from a camel suffering from surra. In two, trypanosomes appeared in the peripheral circulation after an incubation period of 10 days, and in the third after 11 days. The paroxysm lasted two to four days; the blood of each sheep was daily examined for 115 days but no trypanosomes were again observed.

With the object of ascertaining whether old camels are immune to surra a camel 18 years old was procured that had been on the strength of a certain unit for over 13 years, and thus must have been through several surra outbreaks. When inoculated with infective blood, trypanosomes appeared in the circulation on the seventh day after inoculation and were present except on one day until the animal died 18 days after the inoculation. Three one year old camels, inoculated with surra at the same time as this old animal, developed the disease with frequent paroxysms at the commencement, but gradually these became less frequent and all three improved in condition and at the present time would not be suspected of having surra.

In the course of an investigation as to the cause of an outbreak of surra at Chakdara valuable information was obtained as to whether camels suffering from the disease are dangerous to ponies. Tabanidae were swarming in the camp and a high proportion of the camels were infected. After a few weeks 5 out of 14 ponies kept at the same camp were found to be suffering from surra. It is concluded that the ponies contracted the disease from the camels and that thus ponies should not be kept in contact with camels.

The report concludes with a description of an outbreak of anthrax and of another outbreak of a disease of unknown origin.

UGANDA PROTECTORATE. **Annual Report of the Department of Agriculture for the Year ended 31st March 1916.**—62 pp. f'cap. 1916. Entebbe: Government Printer. [Report of the Chief Veterinary Officer [HUTCHINS (E.).] pp. 40–43.]

Rinderpest.—The work of the year was almost entirely confined to the inoculation of cattle in the Mengo district of the Buganda Province, and in bringing a widespread outbreak in that district under control. The disease appeared in the early months of 1915 on the extreme eastern side of the district near the Nile, but early in May it appeared in the Bukoba division of Kiagwe, an area heavily stocked with cattle, the infection having spread from the neighbouring infected areas in Bugerera. Between May 20th and July 26th, 5,007 cattle were inoculated in the Bukoba division; the deaths amongst the non-inoculated cattle were estimated at 1,800, or about 80 per cent. of the non-inoculated stock.

In July the disease further extended into the neighbouring county of Bulemezi and spread rapidly northwards along the Sezibwa River into Buruli. Inoculation camps were formed at two places, where inoculations were carried on until the end of October, to cope with the rapid spread of the disease in Bulemezi.

In October outbreaks occurred simultaneously in other centres, all these being probably due to the illicit movement of cattle from the infected areas in Southern Bulemezi.

Another inoculation camp was opened near Entebbe in November; owing to the prevalence of trypanosomiasis amongst the cattle in the surrounding districts it was not considered advisable to perform the double inoculation. Cattle here were thus inoculated with a protective dose of serum only; in some instances this gave unsatisfactory results as several herds were inoculated whilst in the incubative period.

Many of the herds from Buruli sent for inoculation were found to be heavily infected with trypanosomiasis. In Buruli the buffalo and the bush pig were reported to have died in considerable numbers.

In these districts the total number of adult cattle inoculated was 13,833; deaths, 1,959; calves inoculated, 3,438; deaths, 1,106.

In the Eastern Province rinderpest has been prevalent since it was introduced from British East Africa in 1910; losses appear to have been mainly confined to the young stock.

The Western Province still remains free from rinderpest.

Trypanosomiasis.—Many of the Buruli herds from near Lake Kioga were found to be heavily infected, heavy losses being caused amongst transport cattle. *Glossina morsitans* continues to spread in an easterly direction in Southern Ankole.

Foot-and-mouth disease.—Has been prevalent in Ankole during the past two years, and, in the great majority of cases, it appears in a very mild form.

Diseases of Equines.—Lymphangitis was, as usual, the most common disease amongst mules.

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[Continued from this *Bulletin*, Vol. 4. No. 4, pp. 201–205.]

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